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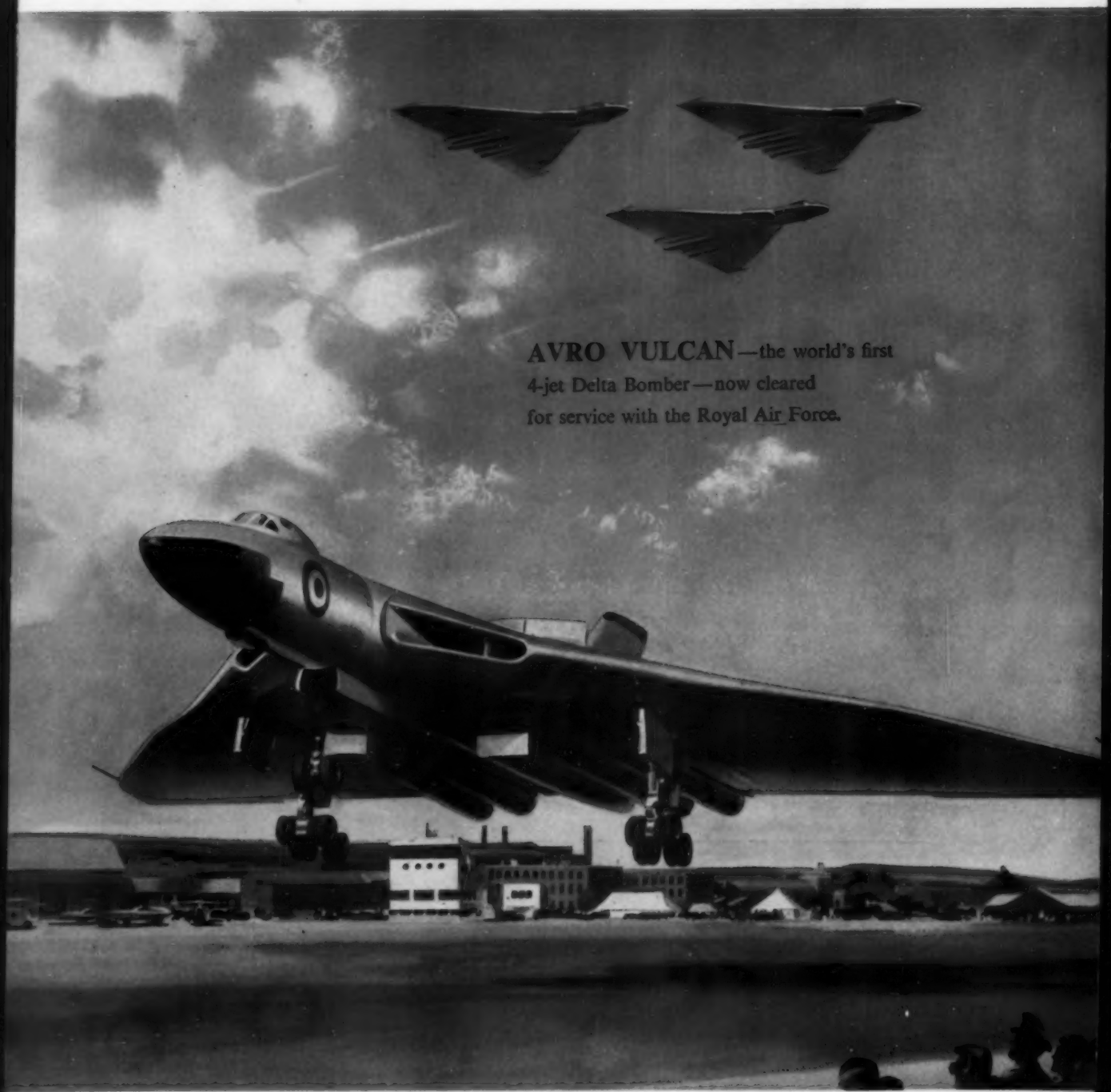

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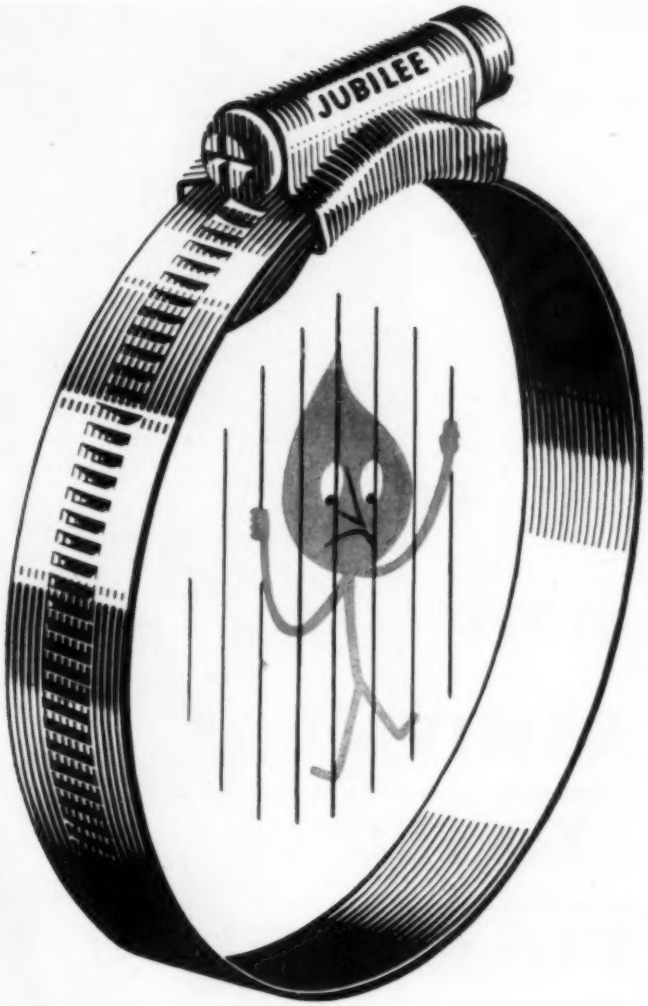

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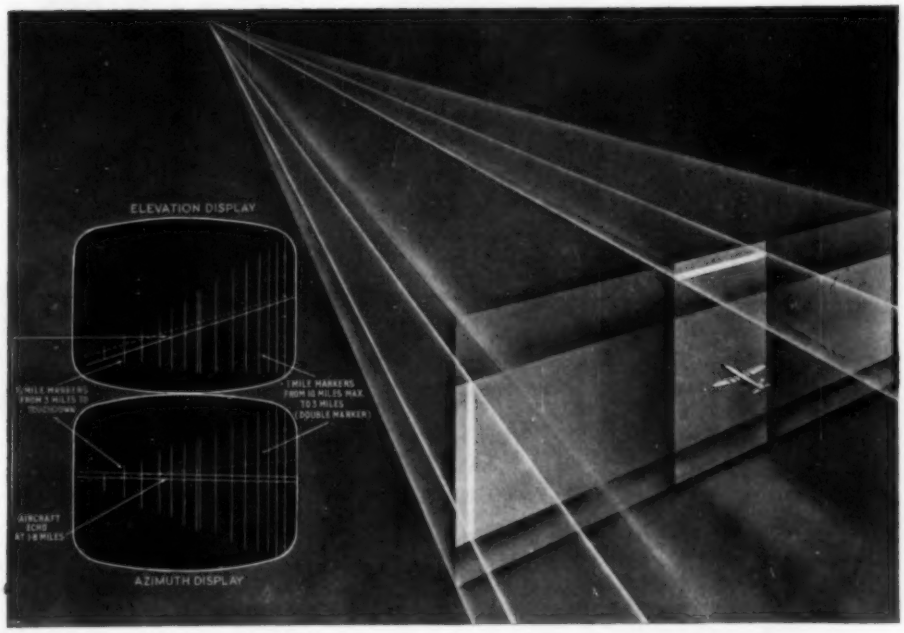

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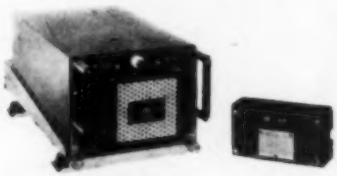
LA 6

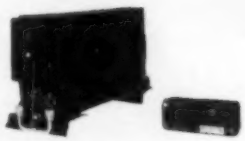
AWA AIRCRAFT RADIO

Australia's aviation industry has been built by the enterprise of the Australian people and today it has an outstanding record of safety and efficiency. By providing much of the airborne and ground radio equipment, and by its Australia-wide servicing organisation, Amalgamated Wireless (Australasia) Limited has contributed in large measure to this proud record.

H.F. Transceiver Type HAC–1·8–10 Channels, 70–80 watts, weight 65 lb. Designed for airline service.



The new Airmite II lightweight VHF Transceiver. 4 channels, weight 15 lb. Range 100 miles. Particularly suitable for light aircraft.



The very successful double-pulse Distance Measuring Equipment. Mandatory equipment in Australia. Maximum ranges of 100, 200 or 300 nautical miles.

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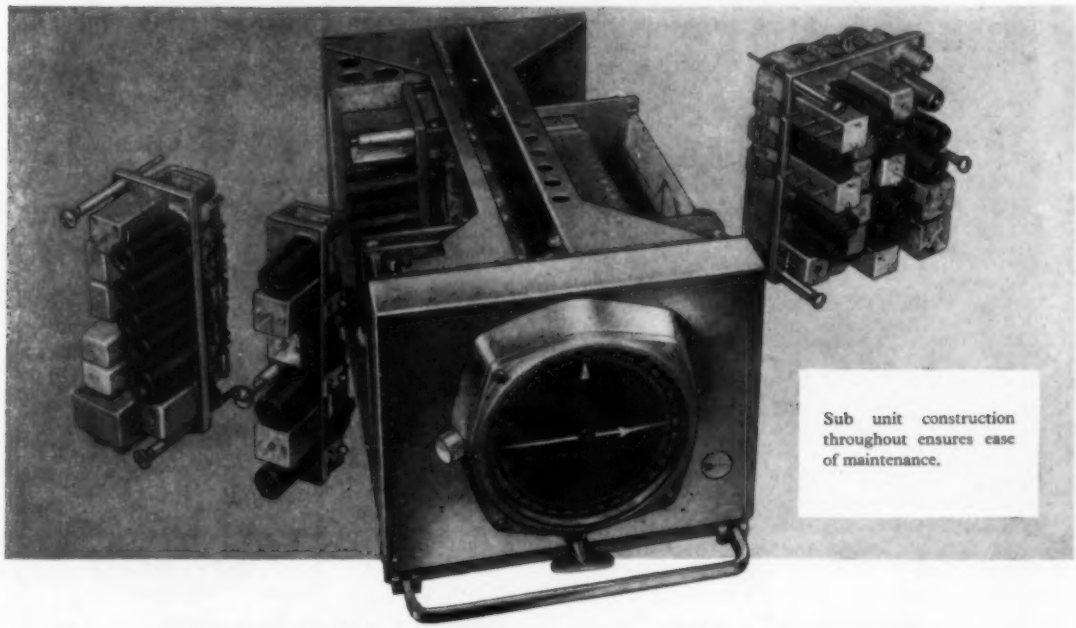

Sub unit construction throughout ensures ease of maintenance.

Type AD712 provides automatic or manual direction finding, radio range and Consol reception

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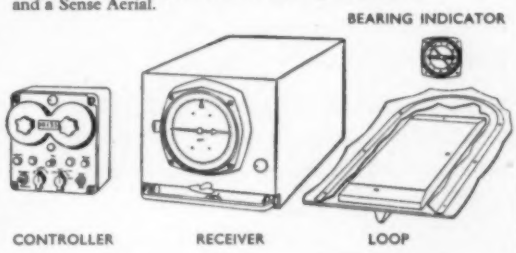
- **Sense aerial of only 5 hi caps required**
- **Sensitivity of 25μ V/m for a bearing accuracy of ±2° (including QE)**

More than forty Airlines and twenty Air Forces fit Marconi air radio equipment. Marconi airport installations are in use throughout the world.

The entire system comprises Controller, Receiver, Loop, QE Corrector, one or more Bearing Indicators and a Sense Aerial.



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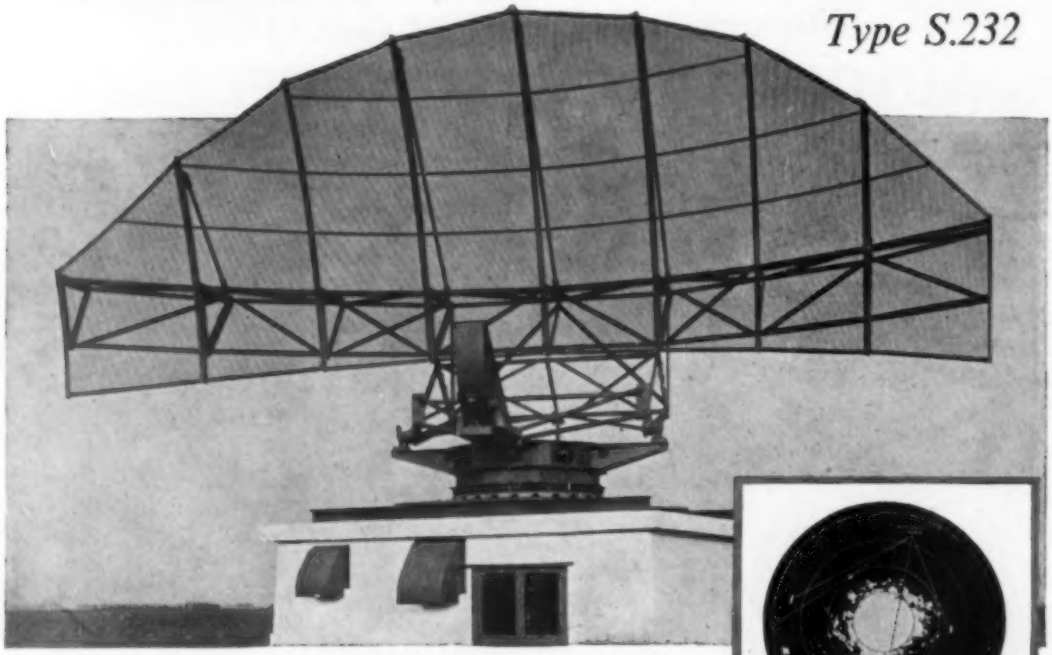
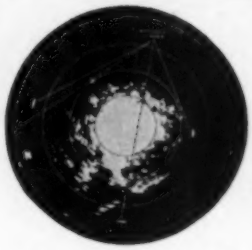
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX

LA 31

Marconi Airfield Control Radar

Type S.232





The photograph above is of the P.P.I. display with the M.T.I. switched off, that below shows M.T.I. switched on and all unwanted ground clutter eliminated.

OPERATES AT FULL EFFICIENCY IN ALL WEATHERS

The S.232 operates in the 50 cm. band using a wavelength which is long enough to be unaffected by cloud and rain. This also gives more efficient radiation from the aerial system, thus longer ranges can be achieved for the same power output and aerial gain than with short wave lengths.

CUTS OUT 'PERMANENT ECHOES' FROM MOUNTAINS, BUILDINGS, ETC., WHICH OBSCURE AIRCRAFT RESPONSE

Unwanted ground clutter can be eliminated in the S.232 by an extremely efficient Moving Target Indicator (M.T.I.) system which feeds only echoes from moving objects to the display.

IS INSTANTLY OPERATIONAL AT ITS RATED PERFORMANCE

The S.232 is crystal controlled and the equipment can be switched on without any subsequent tuning. The M.T.I. system needs no time to settle down.

Marconi Ground Radar is used by 18 Air Forces.

Lifeline of Communication

MARCONI

Planning and Installation of Military and Civil Radar Systems

MARCONI'S WIRELESS TELEGRAPH CO. LTD., CHELMSFORD, ESSEX

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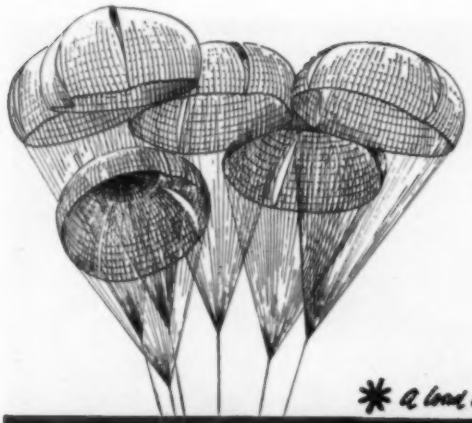

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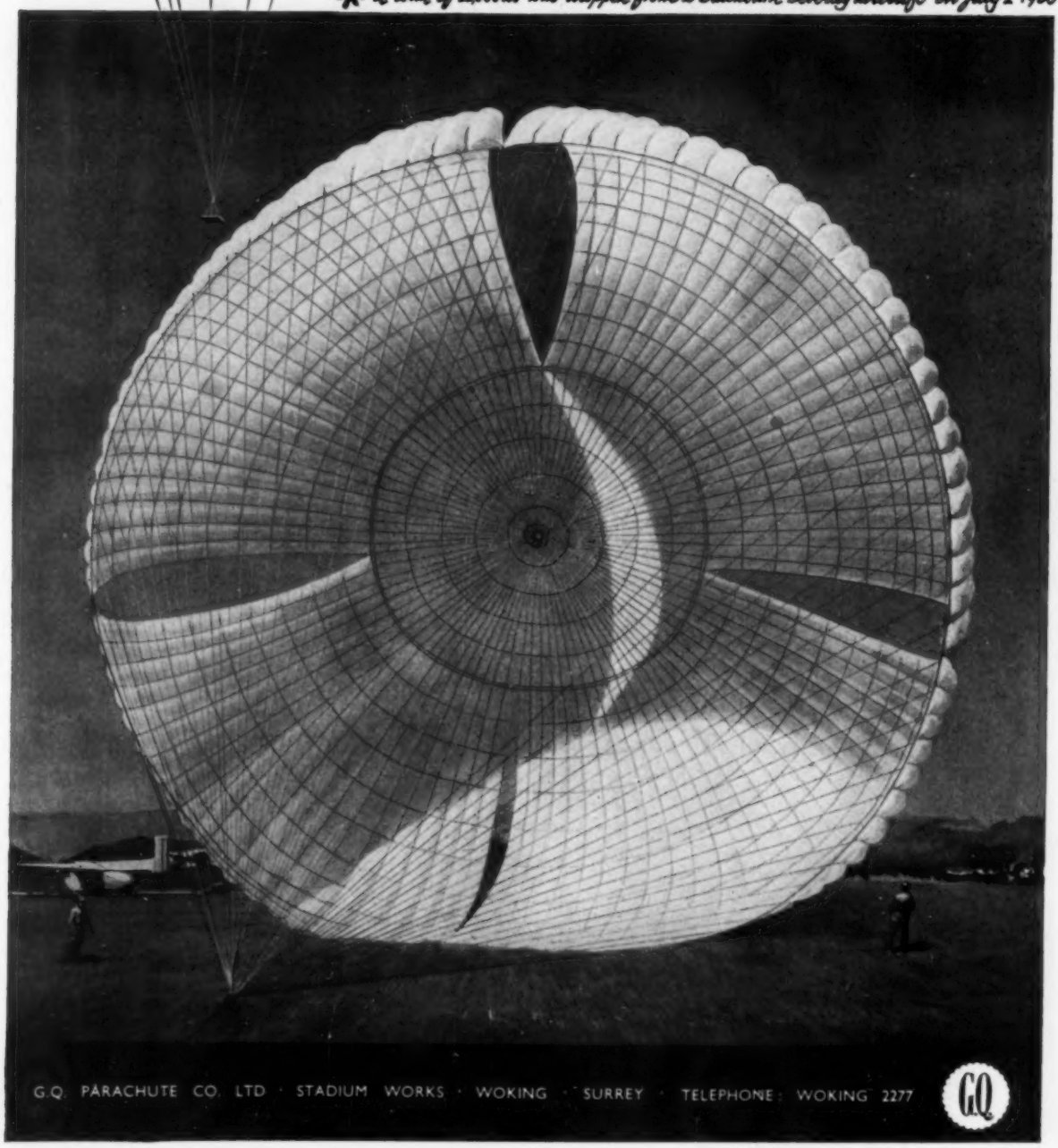
Loads of ~~20,000~~ 22,000 lbs have been dropped successfully from the Blackburn Beverley on 6 G.Q. 66 ft. Dia. parachutes.

These parachutes, which have an individual load capacity of 3,000 lbs, may be easily dismantled into five sections for repair and handling in the field. Like other G.Q. parachutes of advanced design they are extremely stable in flight.

* A load of 22,000 lbs was dropped from a Blackburn Beverley aircraft on July 2 1956



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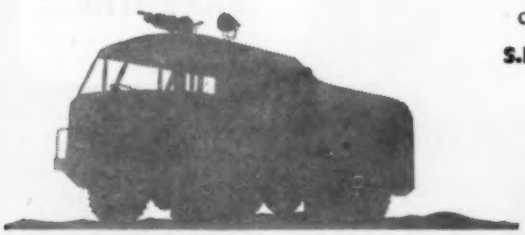

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night flight to Barcelona

(Photo by courtesy of British European Airways)

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The passengers, weighed, farewelled and Customed, are strapped snugly in their seats. The pilot has been through the long pre-take off routine. Everything's ready—'plane, passengers, crew, food, drink—and fuel. Yes, fuel. It came from a storage tank fitted with a Simmonds Contents Gauge and a Simmonds Pump Controller. It went through a Simmonds Separator Filter, ensuring clean, water free fuel in the aircraft tanks. And here in the 'plane the pilot can see the fuel load registered on Simmonds Pacitor Fuel Gauges and Simmonds Flowmeters. Does the name Simmonds keep cropping up? It always does where there is aviation fuel.

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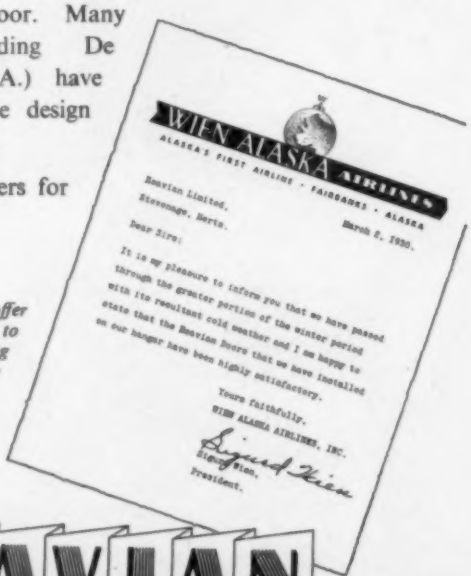
Esavian are pioneers for the jet age.

Our technical staff can offer a wealth of information to architects and consulting engineers who have special problems.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Esavian Limited,
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Yours faithfully,
WIEN ALASKA AIRLINES, INC.
Signed Wien.
President.

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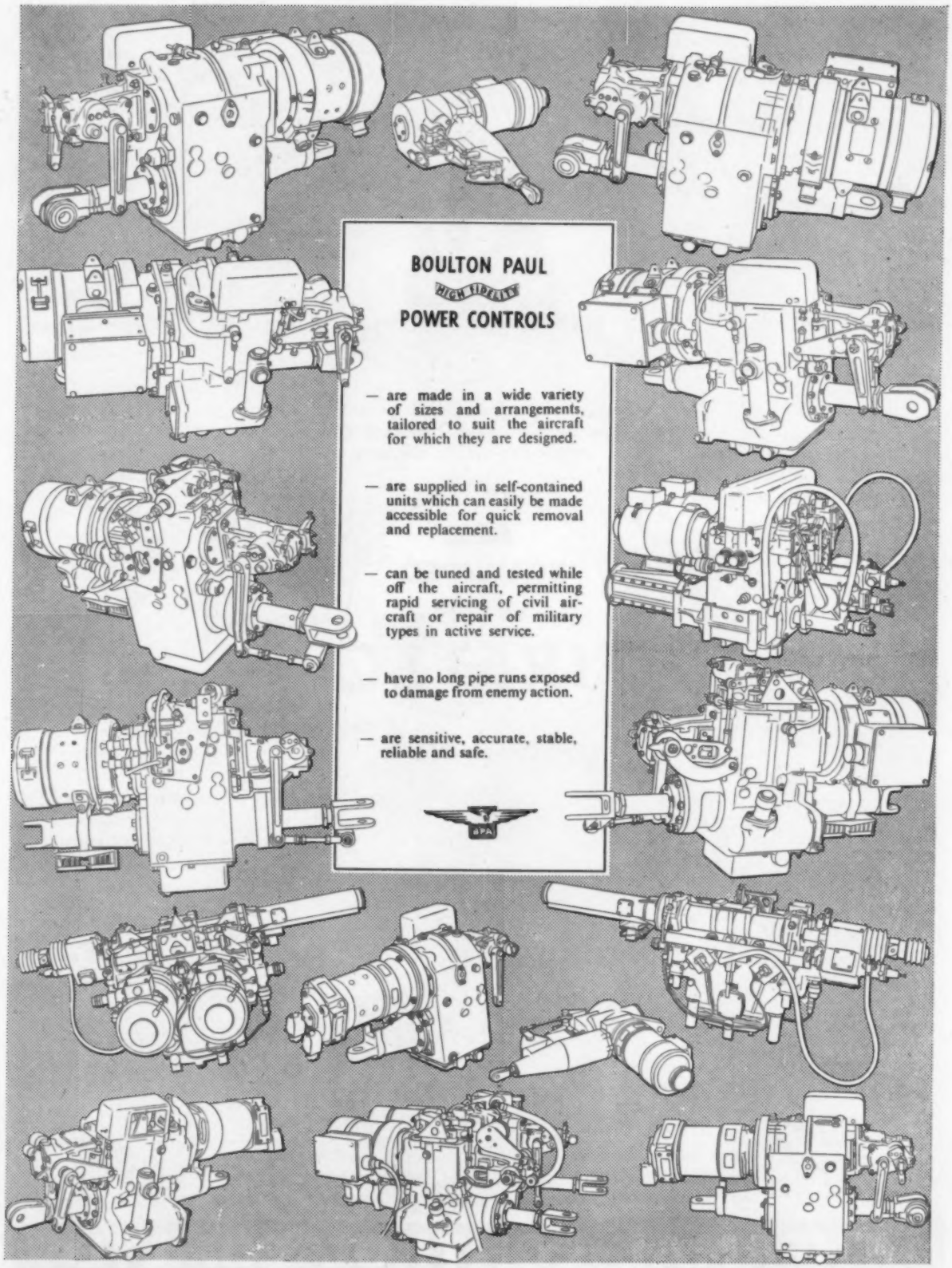
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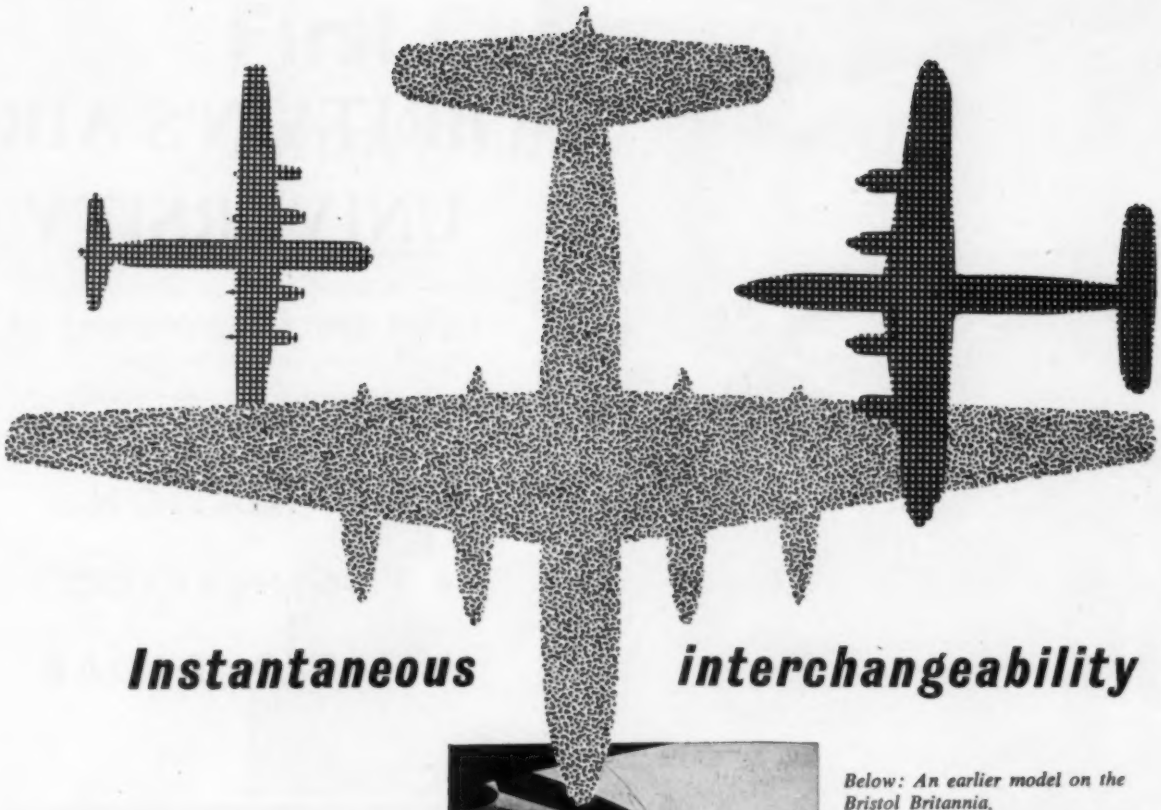

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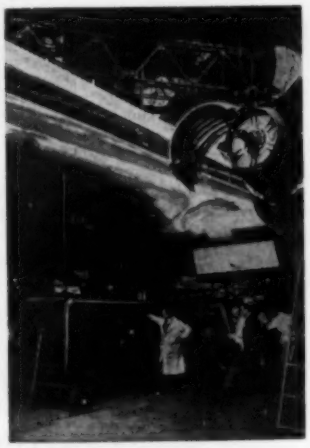
Above: The 1956 Mark III rig on a Stratocruiser.

Below: An earlier model on the Bristol Britannia.



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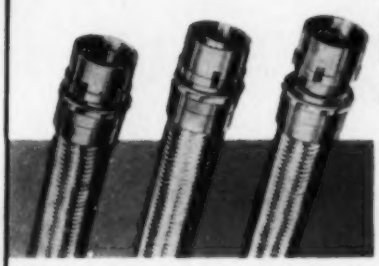

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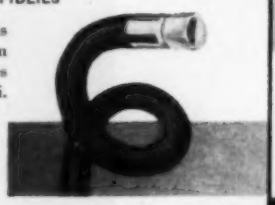

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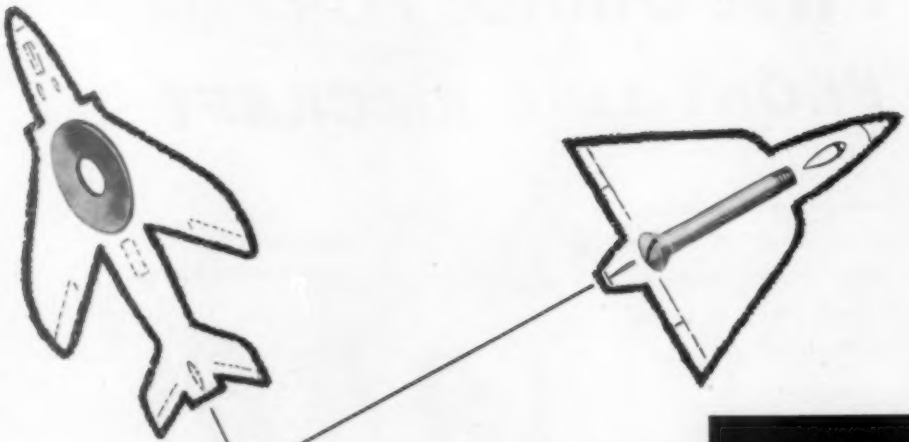
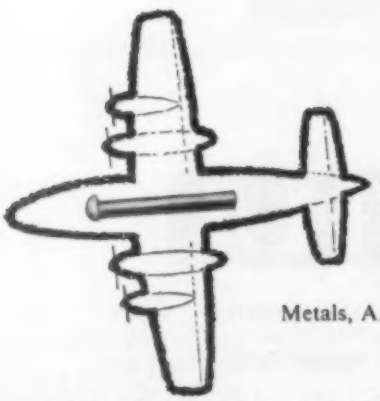


There are millions of them at Farnborough. And nuts, bolts and rivets too. They're flying high with the fastest fighters, wide and handsome with giant air liners. In the brilliant flash of silver and the thrill of speed, these tiny components that we supply may pass unnoticed — but remember, it's the small parts that keep the big planes flying.

ever seen a washer with wings?



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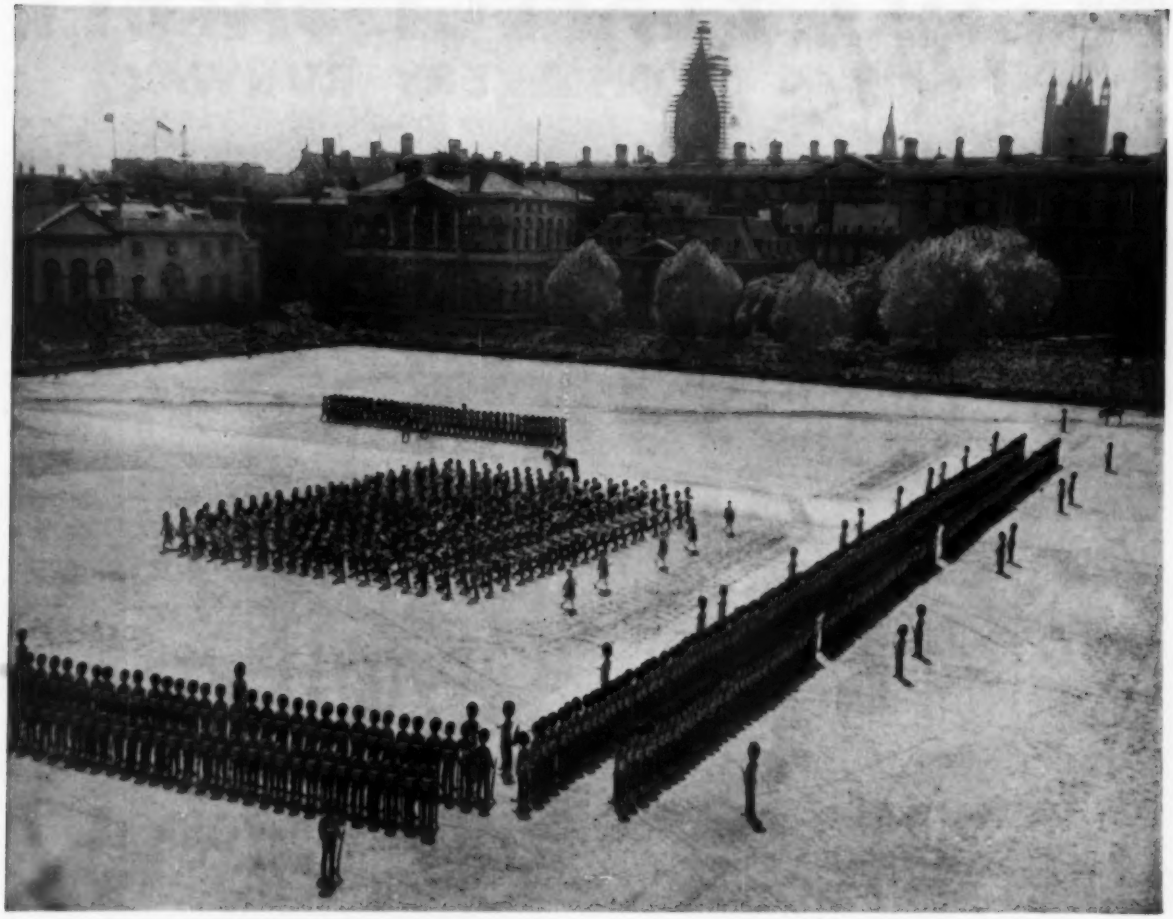
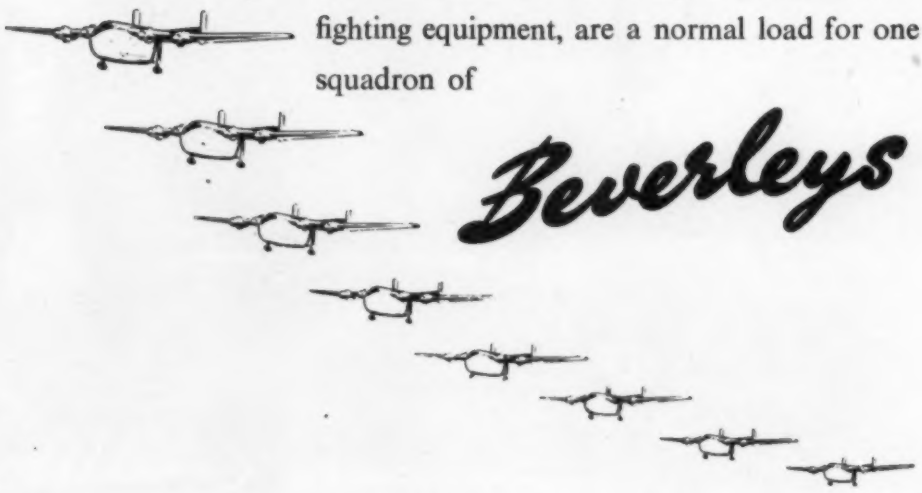


The 800 soldiers in this parade, with their fighting equipment, are a normal load for one squadron of



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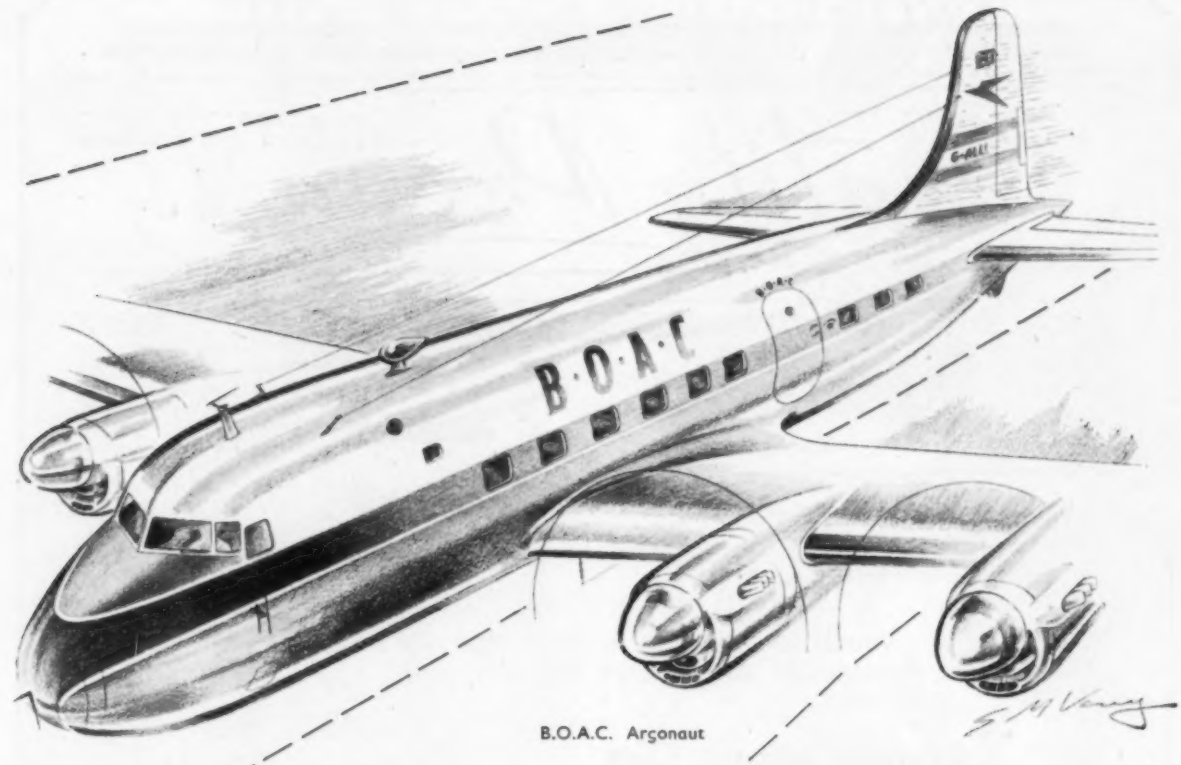

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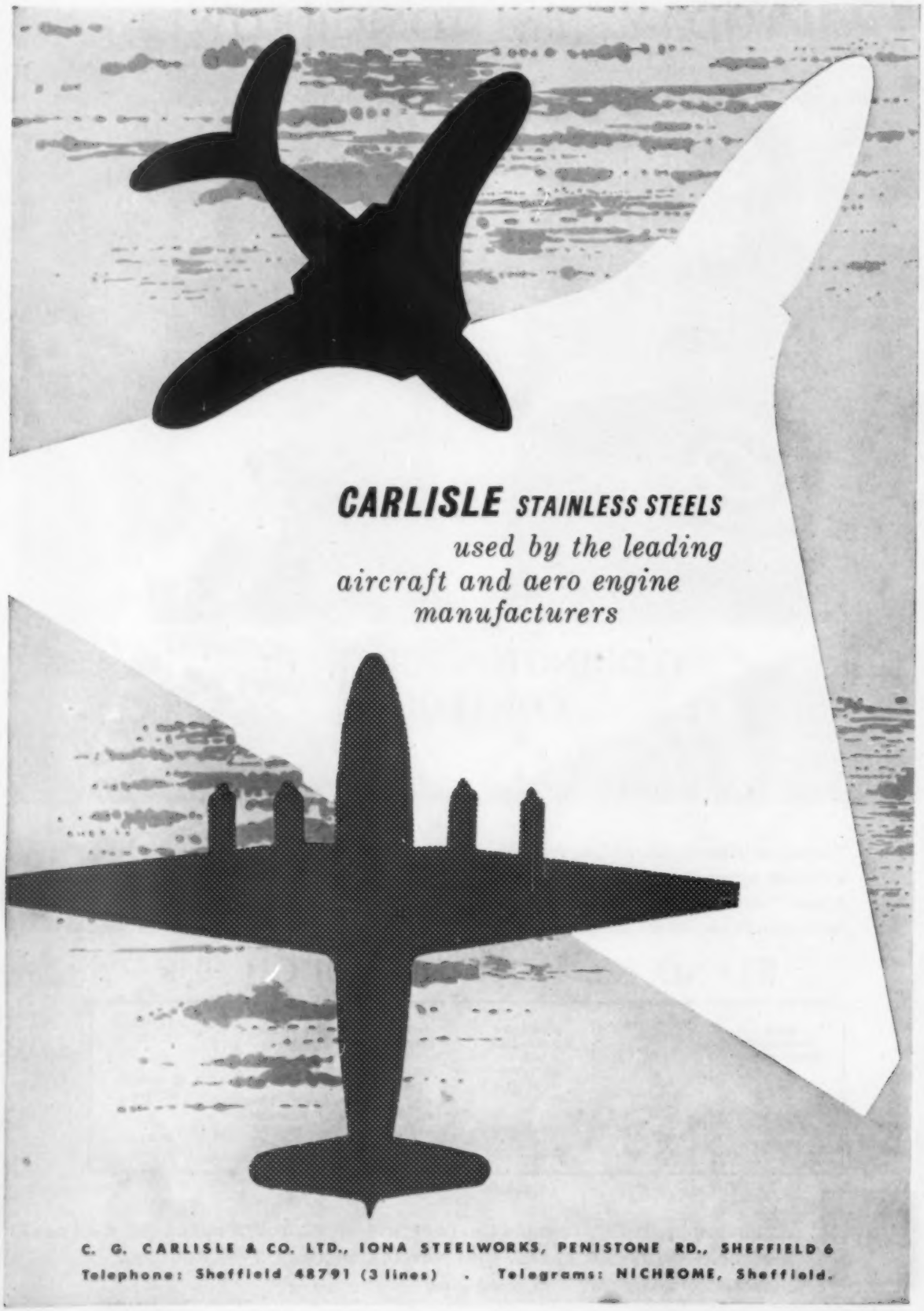
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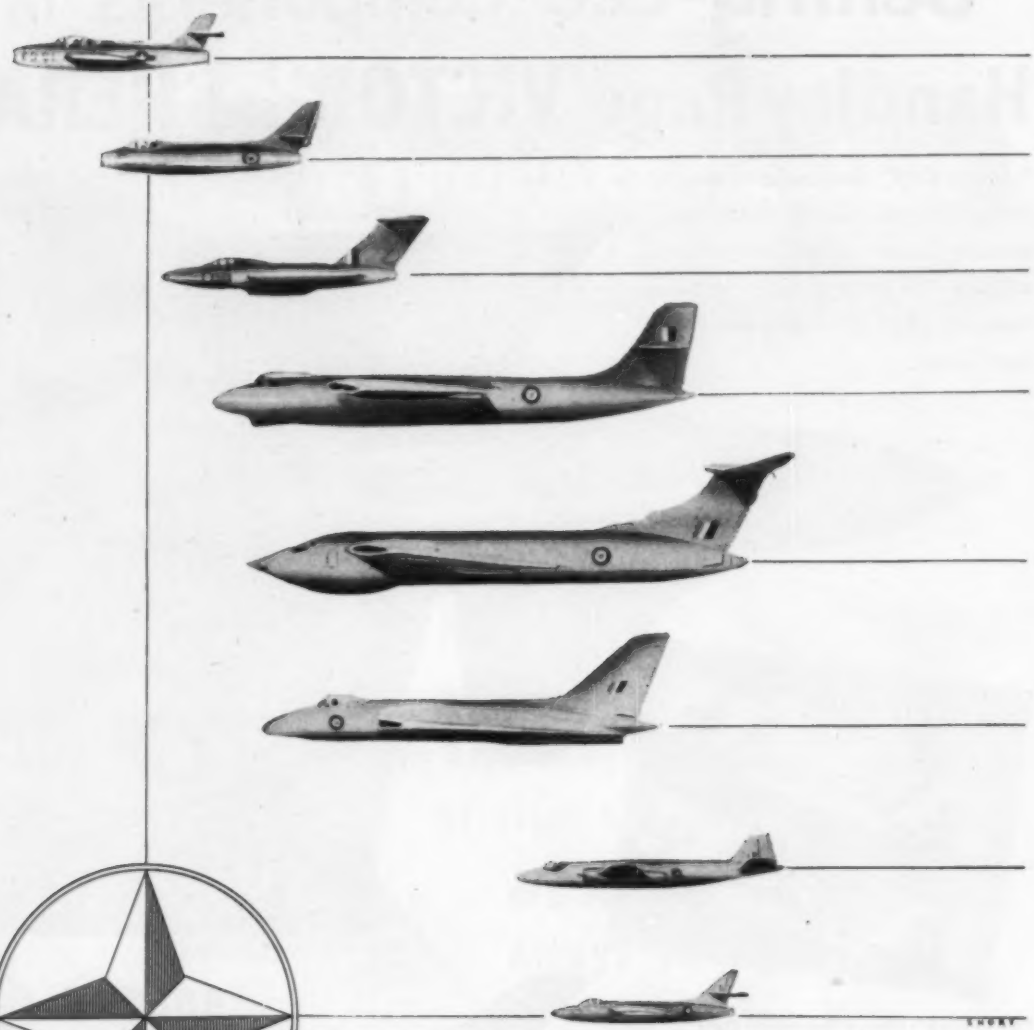

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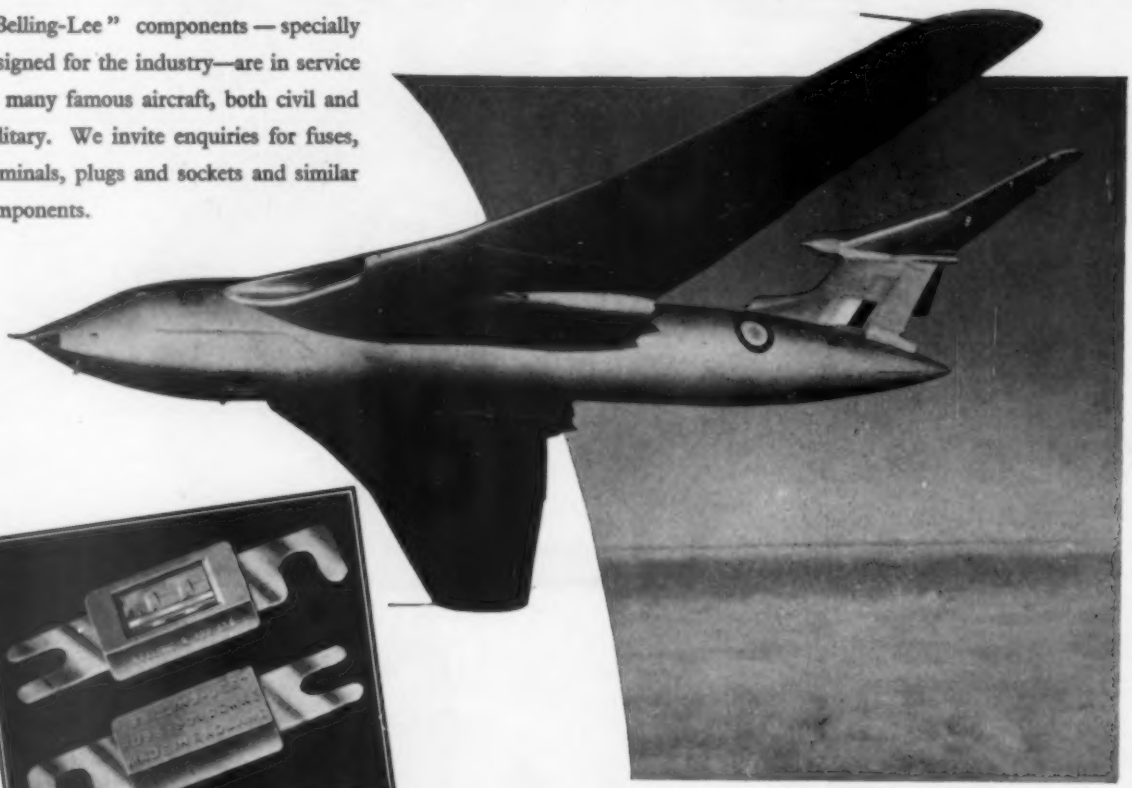

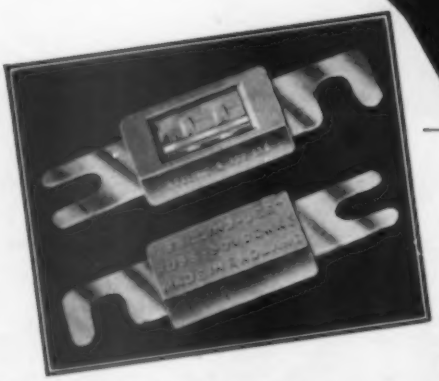

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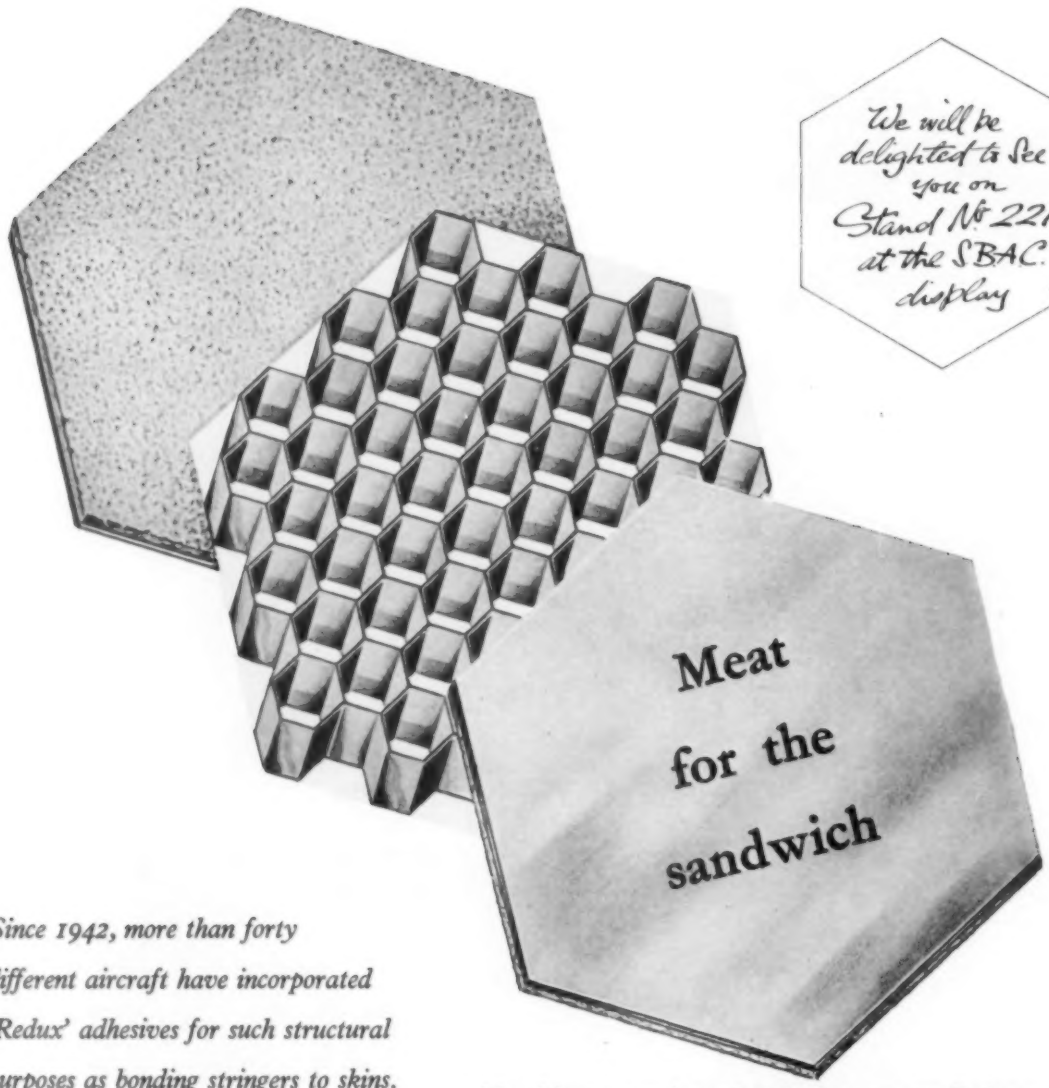

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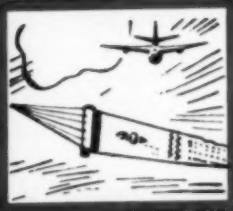

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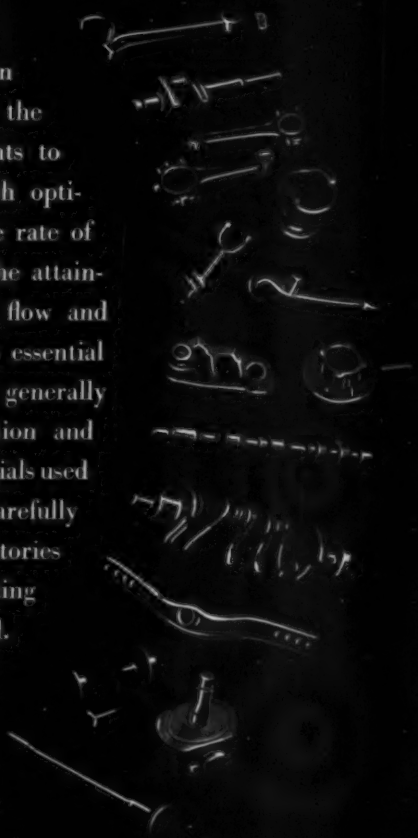

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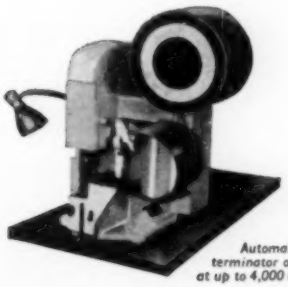

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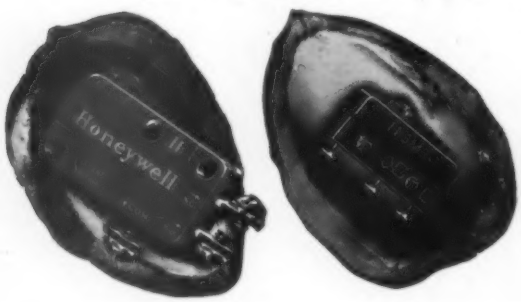

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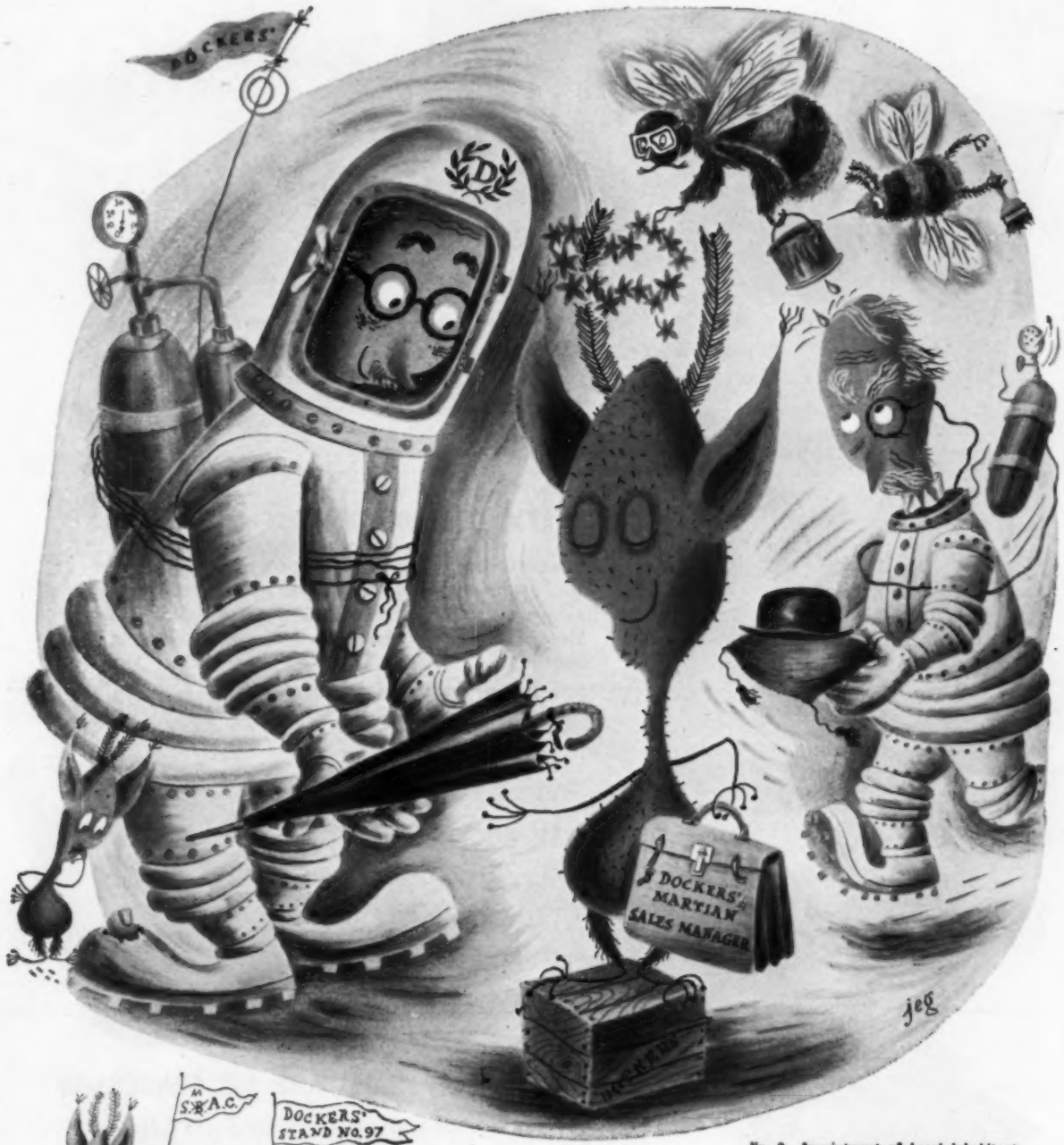

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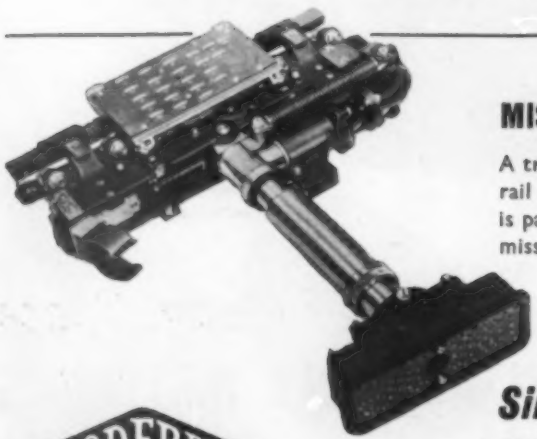

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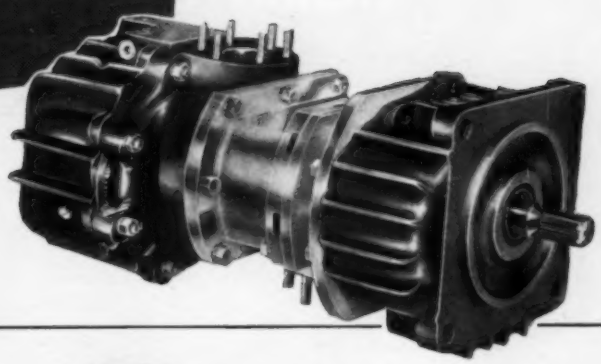

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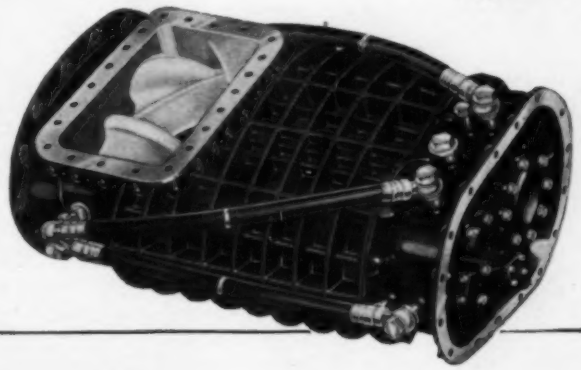

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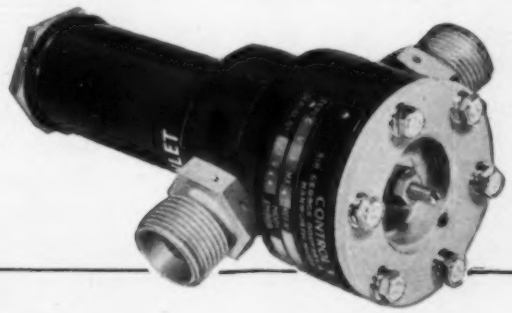

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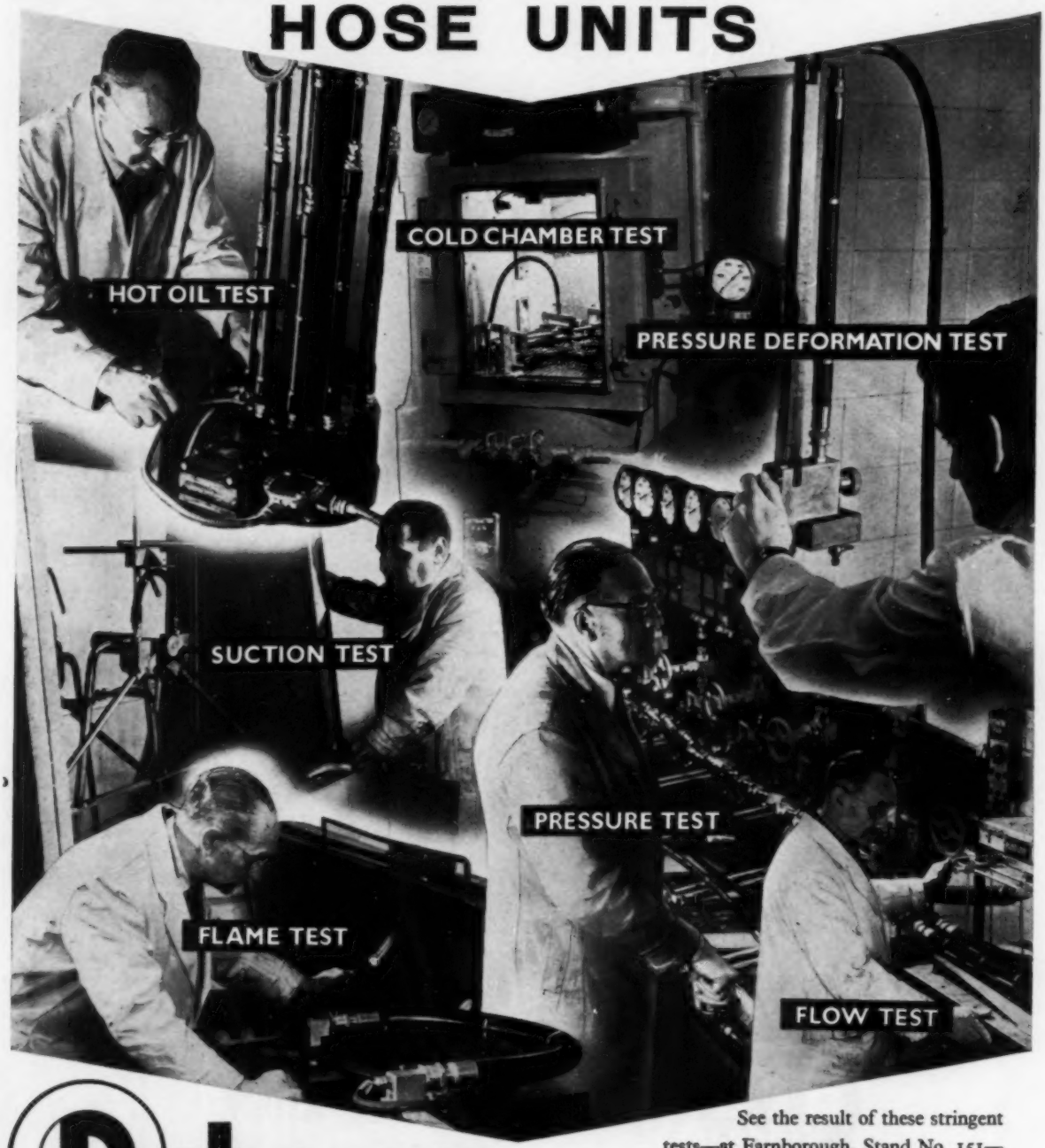

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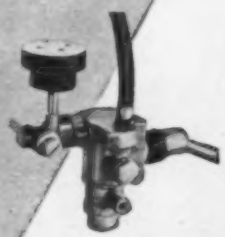

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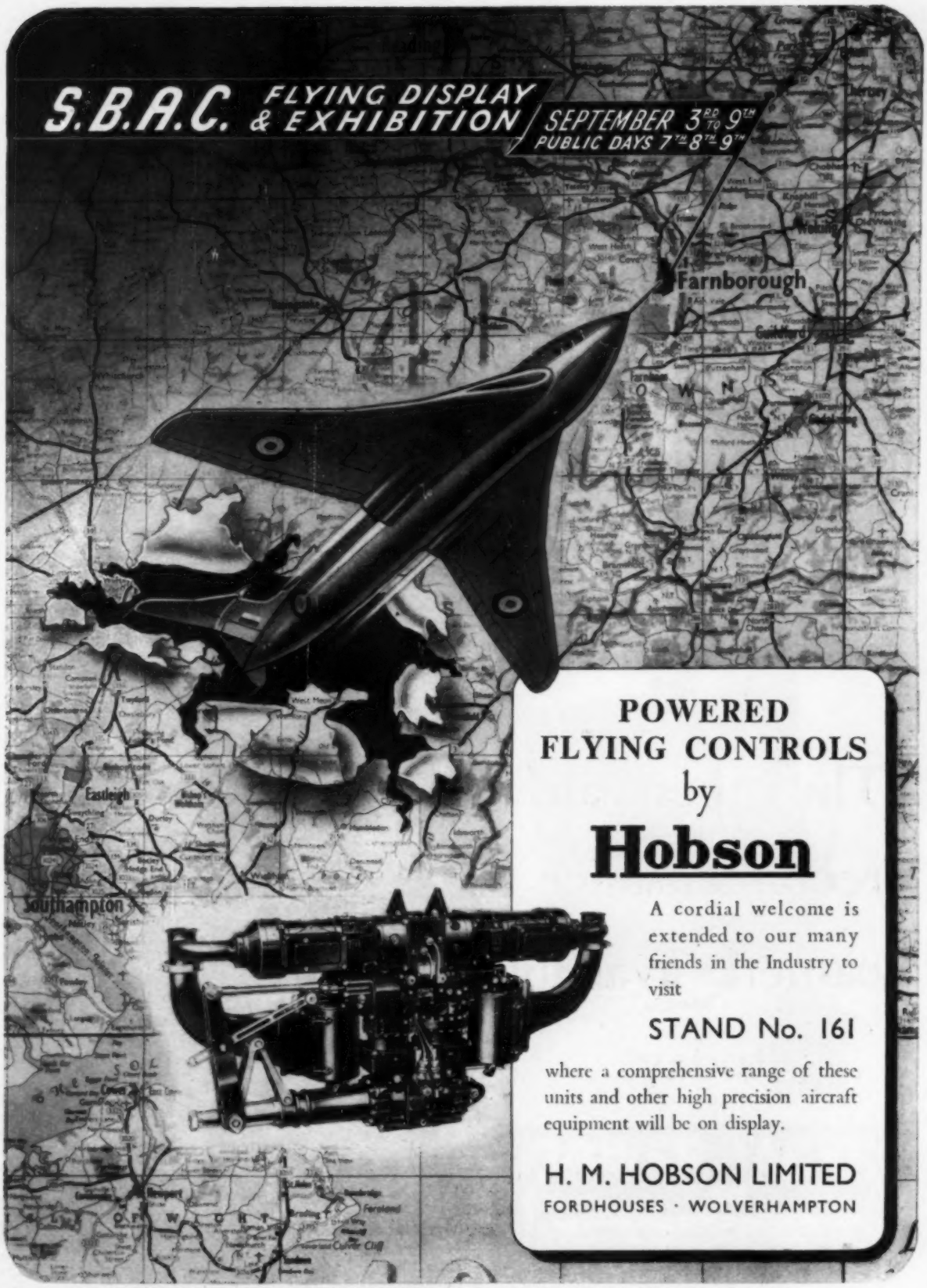

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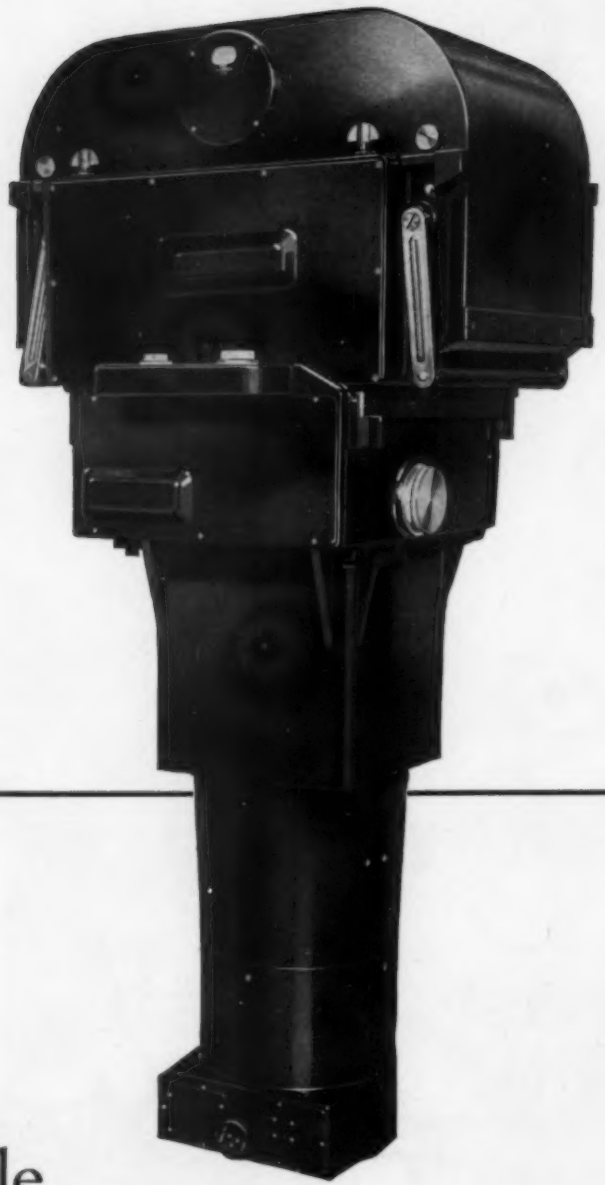

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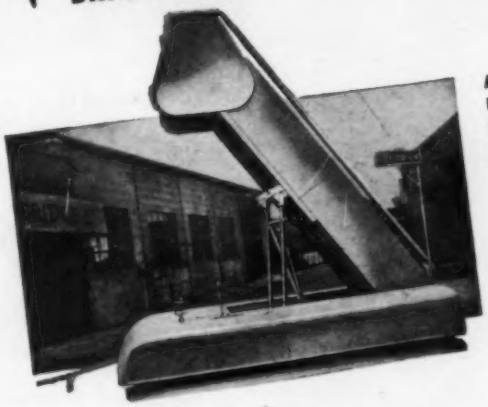
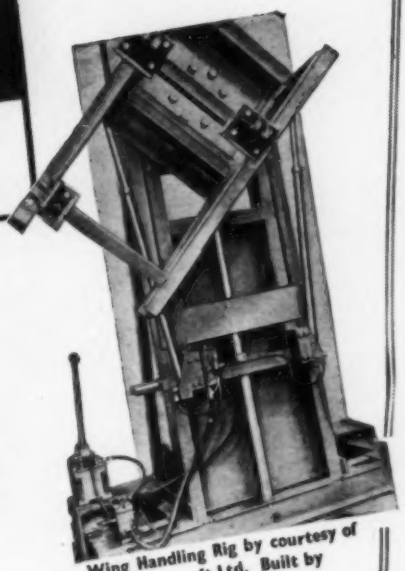


Aircraft Passenger Gangway by courtesy of B. F. Collingridge Ltd. Feltham, Middlesex



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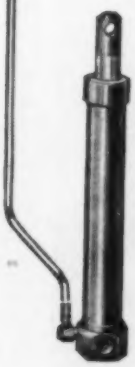

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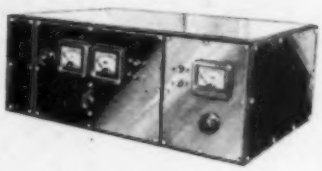

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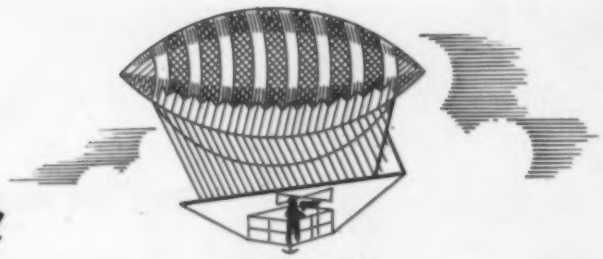

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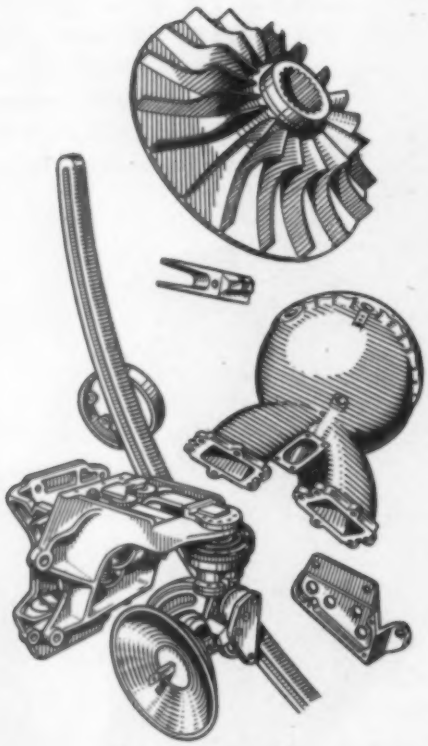

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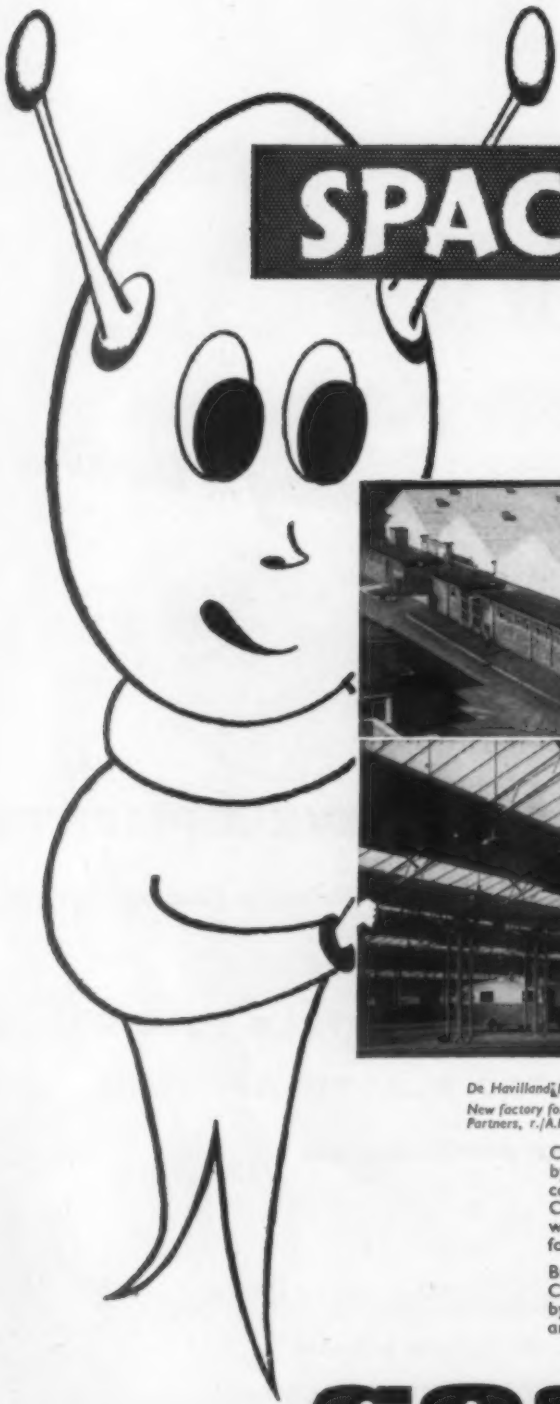

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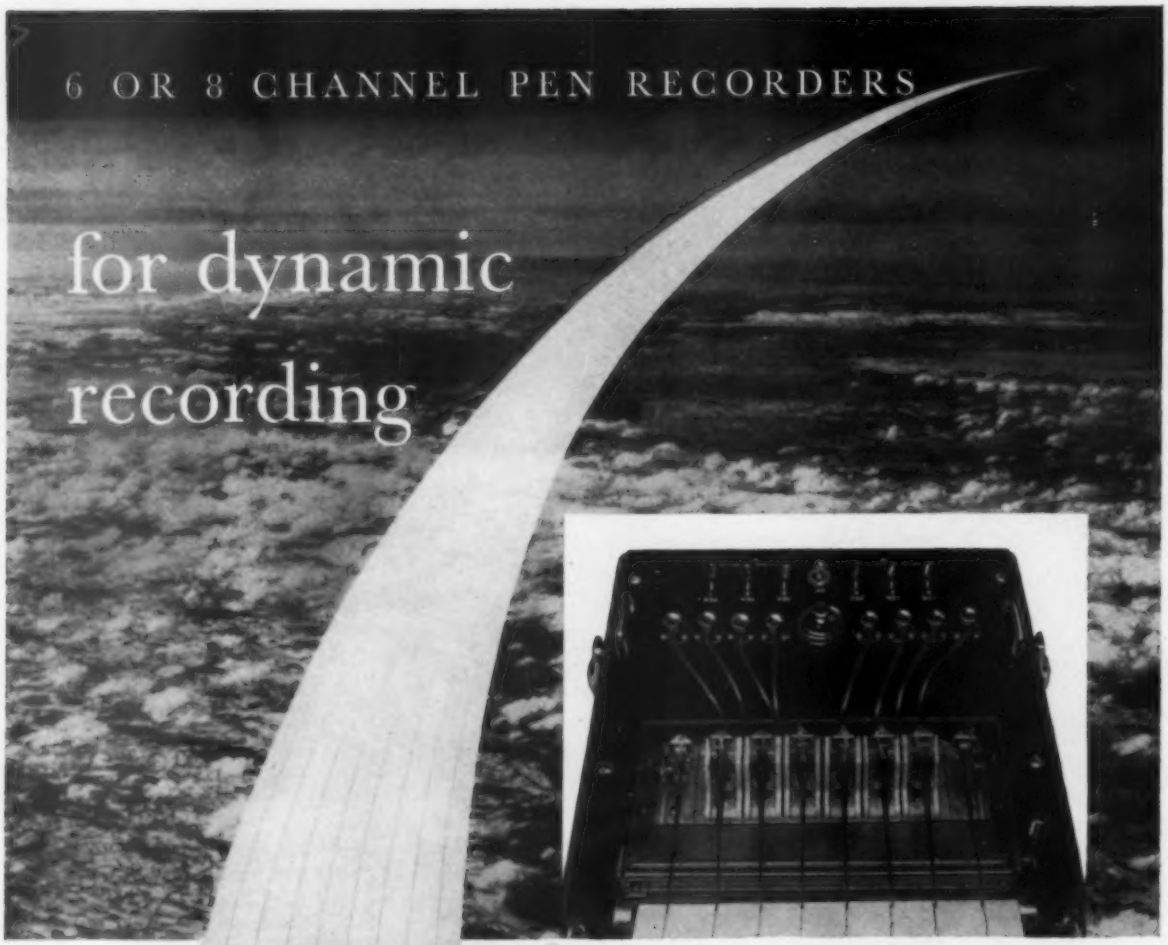

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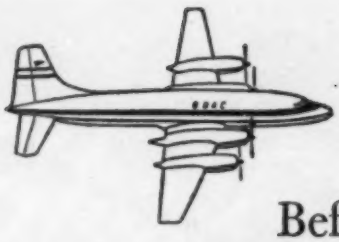

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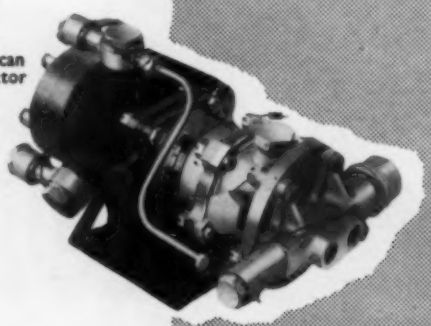

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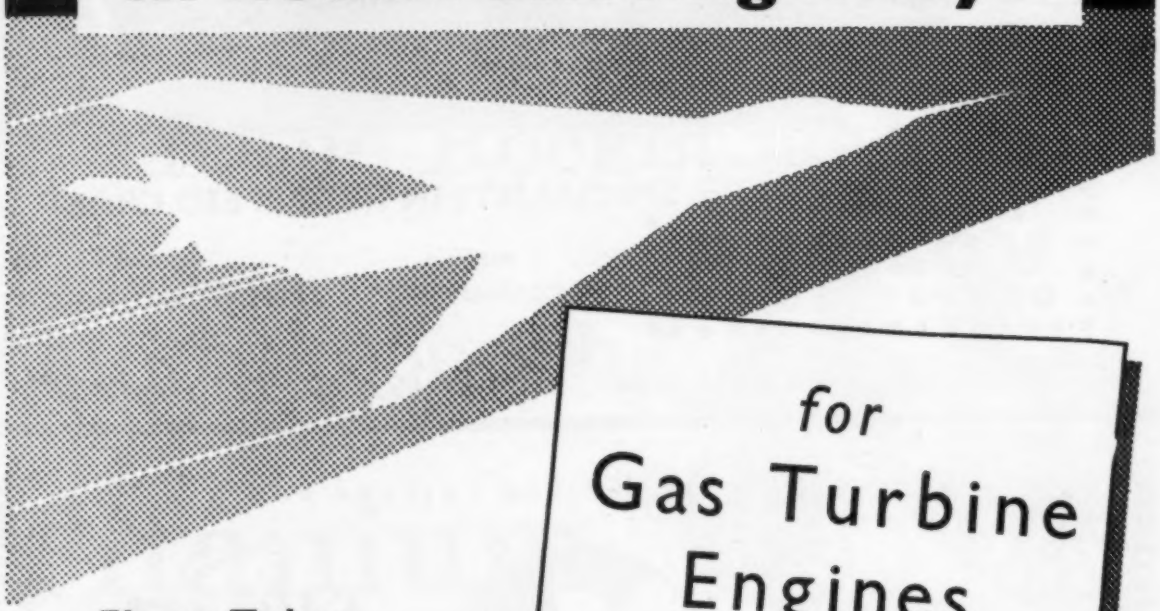

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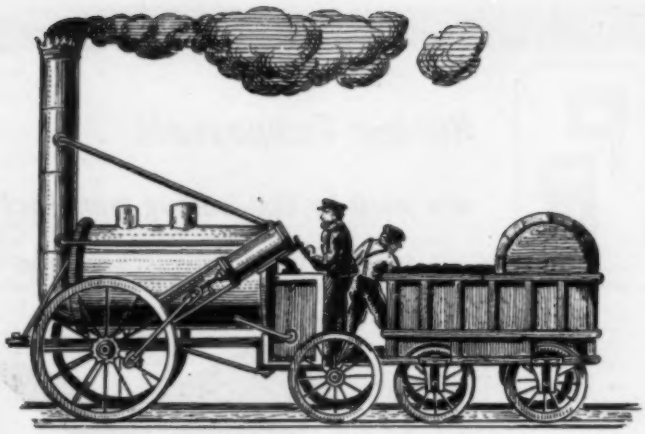
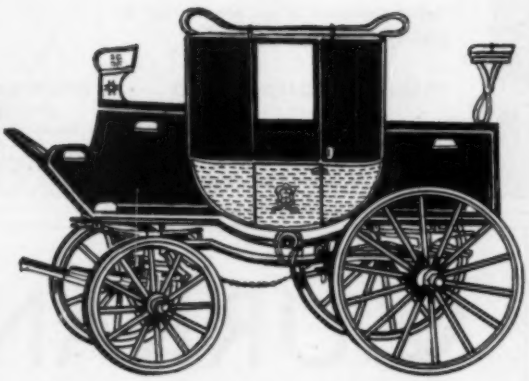


What the Rocket was to the stagecoach



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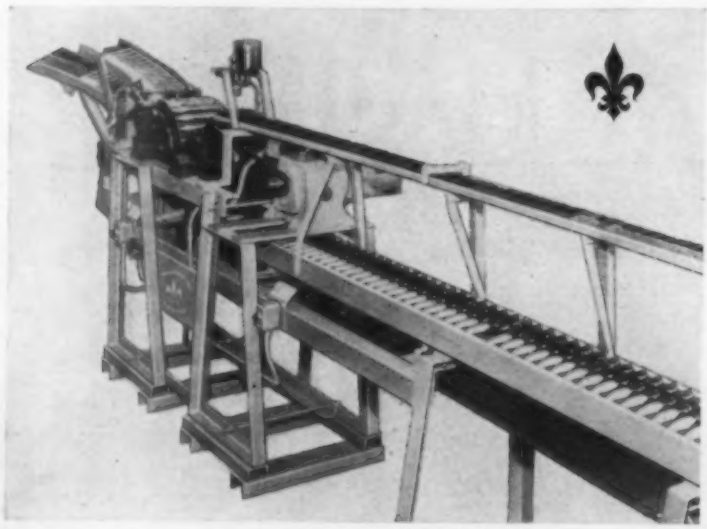

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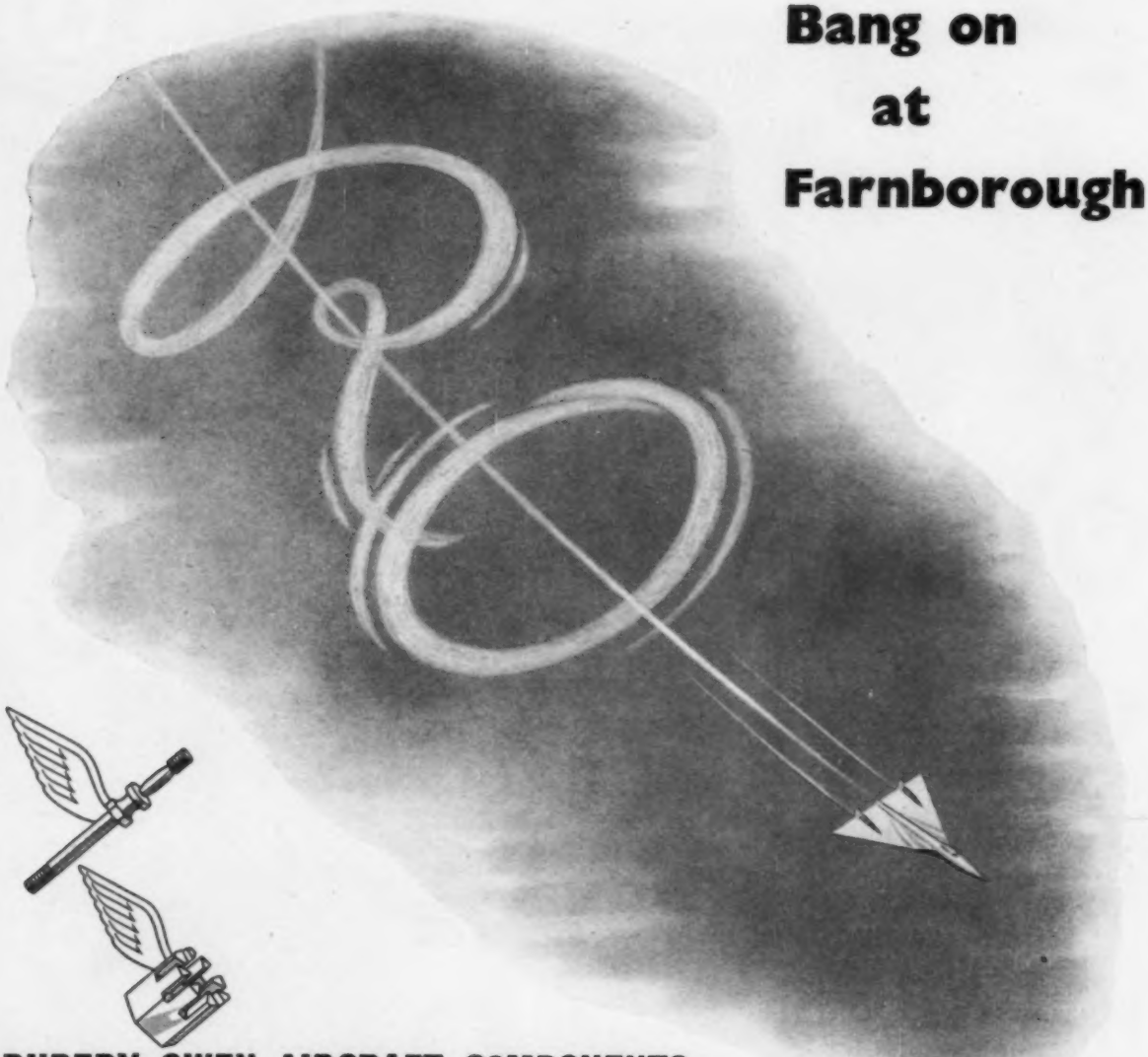

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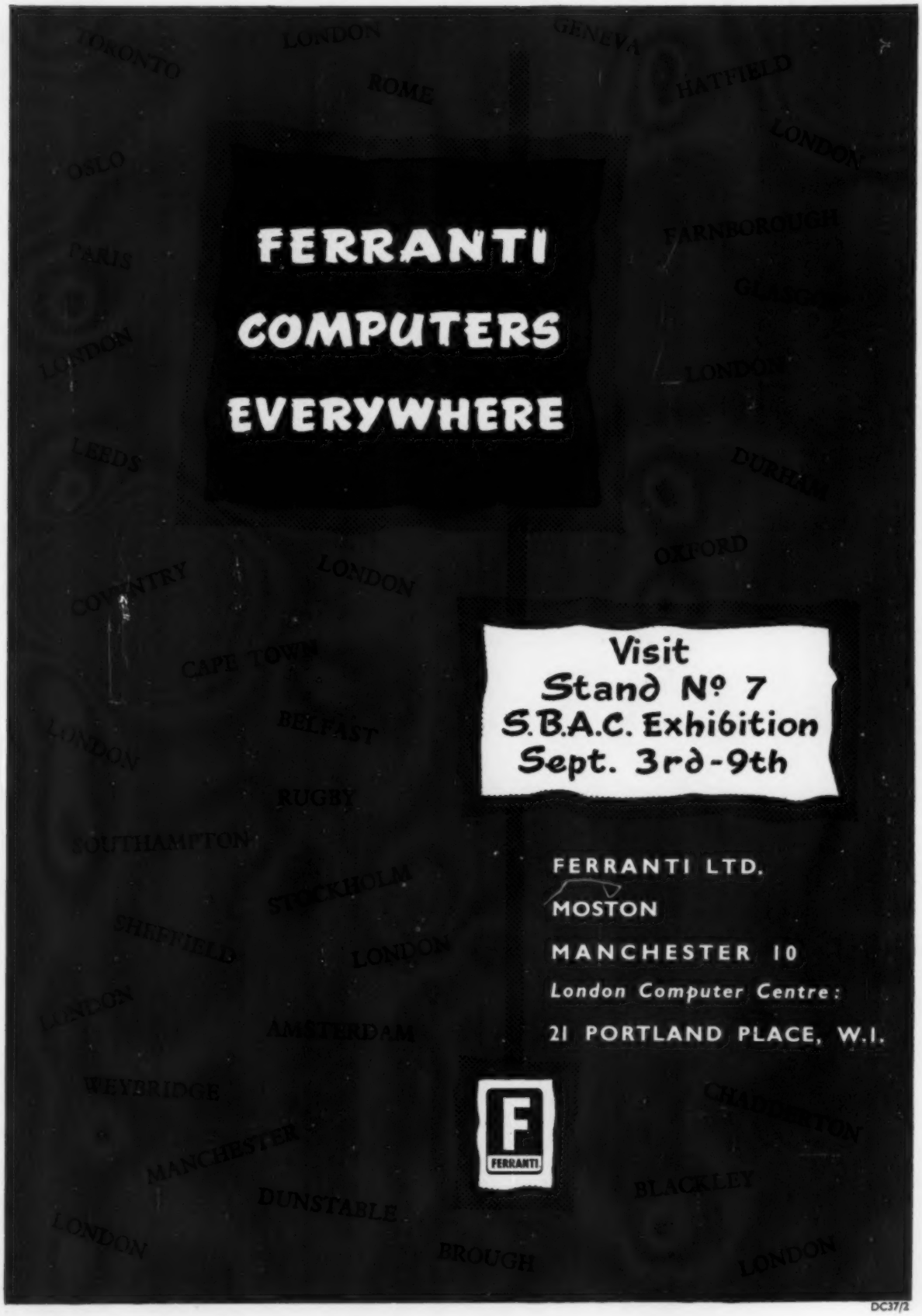
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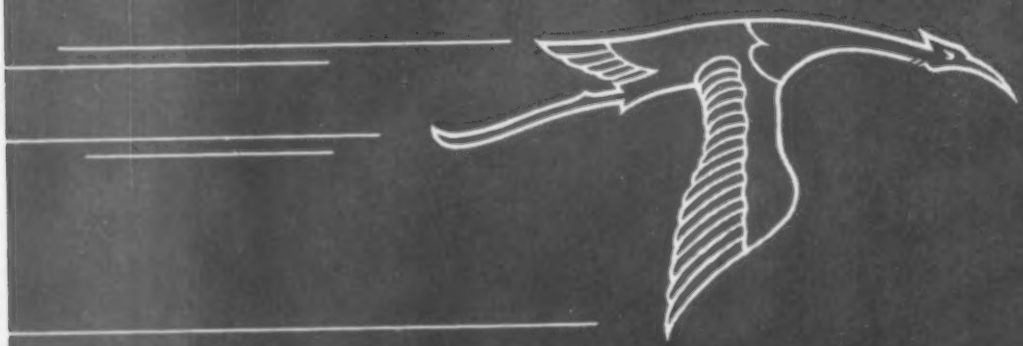

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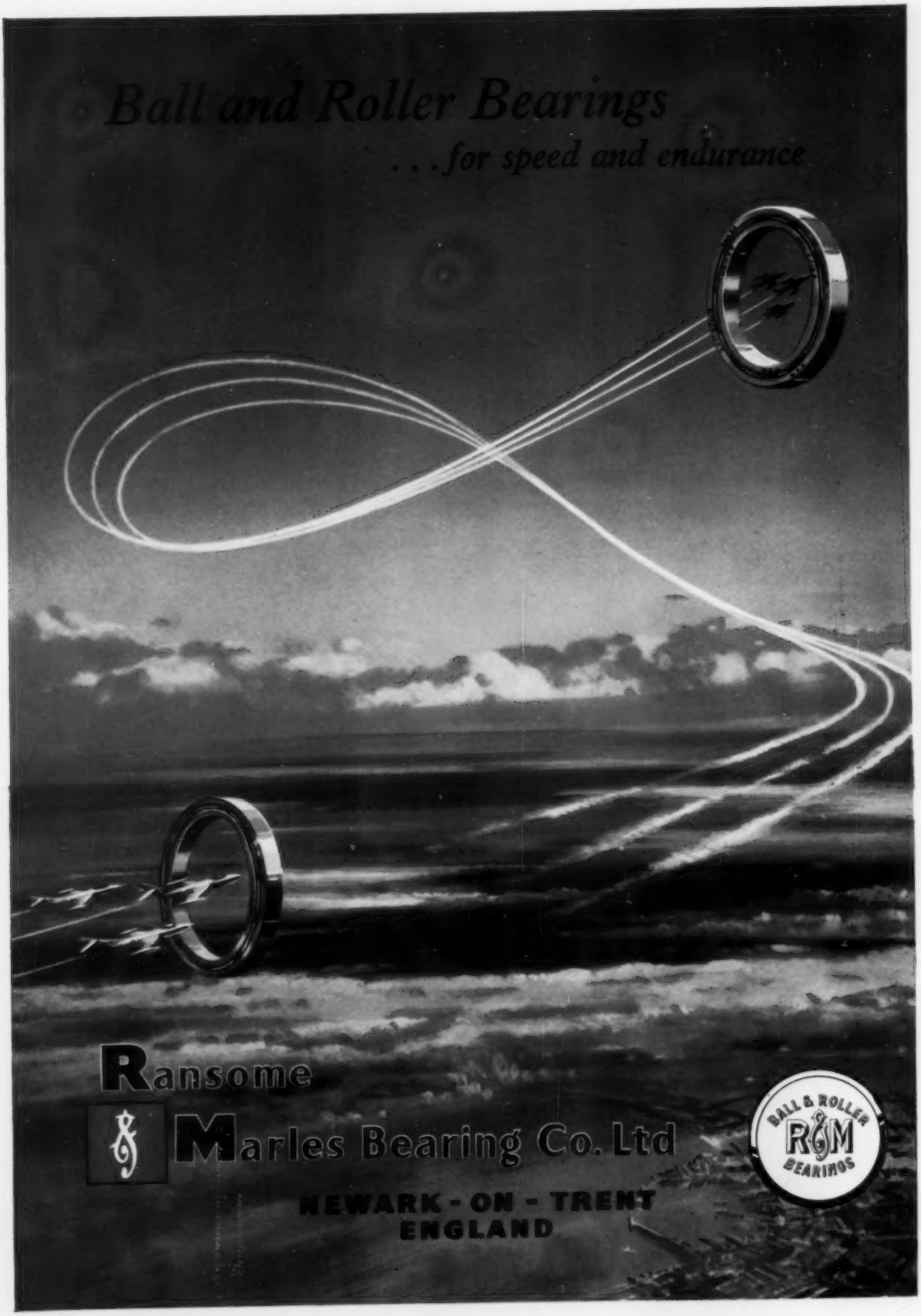
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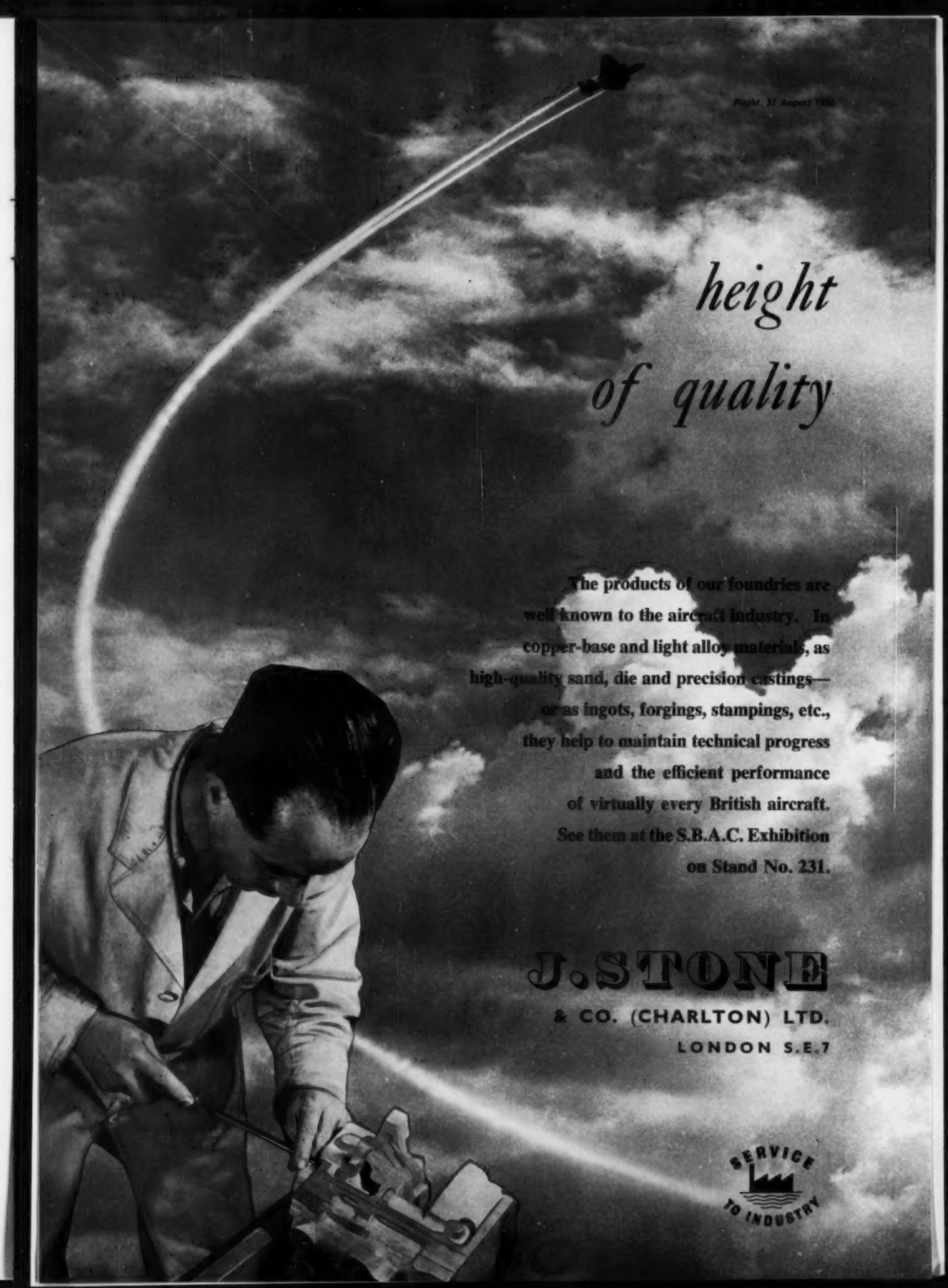

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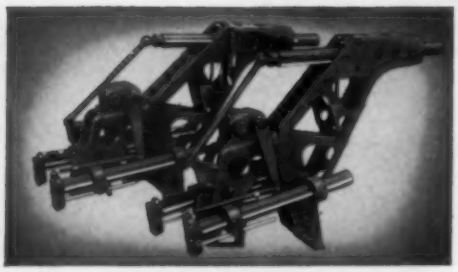

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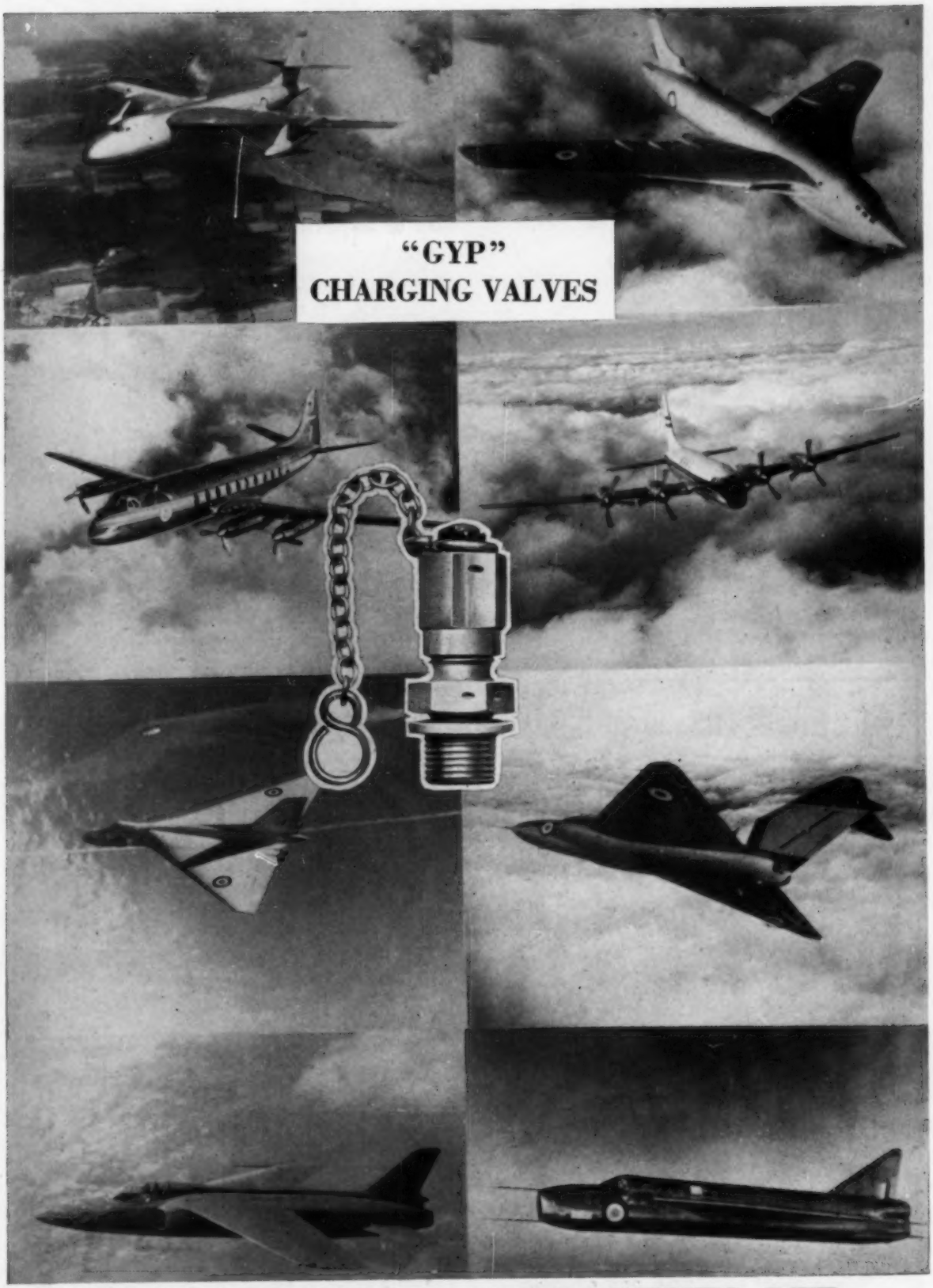

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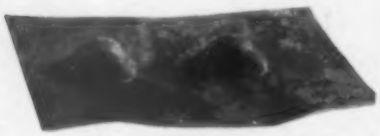
Exhaust manifolds coated with Ferro-Solaramic have now reached 6,000 hours and are still in perfect condition. Without the coating a life of no more than 2,000 hours could be obtained before severe intergranular attack took place. On these facts Ferro-Solaramic is now standard on the exhaust manifolds of all Hercules and Centaurus engines, on Vickers Viking, Valletta and Varsity Aircraft and on the Blackburn Beverley which is also powered with the Centaurus and has the entire exhaust system coated.



Section of Hercules manifold after 4,600 hours subjected to an Eriksen test.

Hercules exhaust manifold and pipes fitted to Hermes aircraft. Similar manifold and pipes protected from corrosion by Ferro-Solaramic have done 6,000 hours' service and are still in perfect condition. Note the slip joints are coated with Ferro-Solaramic on the mating surfaces and do not stick in operation.

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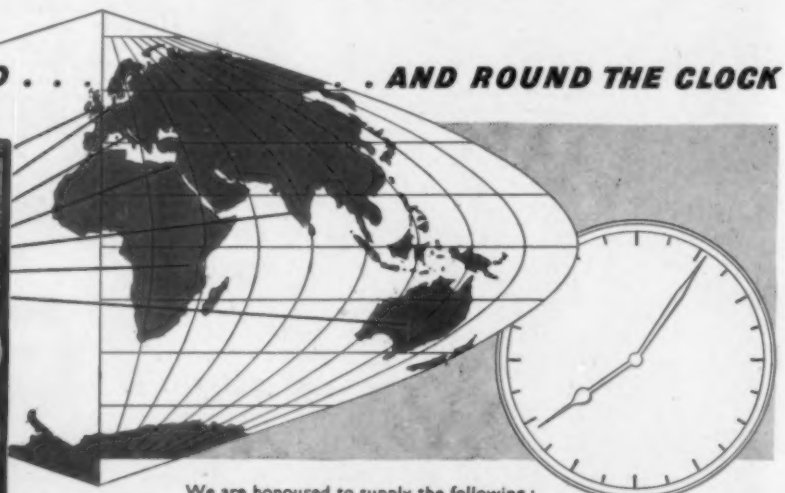

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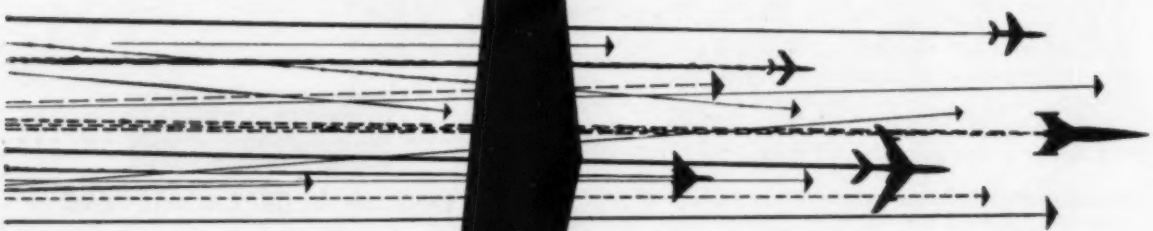

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FLIGHT
and
AIRCRAFT ENGINEER

No 2484 Vol 70 FRIDAY 31 AUGUST 1956

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On the Threshold

WE British consider it, or are supposed to consider it, bad form to recite our pedigree. So in introducing ourselves, as a nation of aircraft builders, on the threshold of Farnborough (this issue of *Flight* makes a serviceable doorstep) we must be circumspect. It will become us, in fact, to declare our failings first.

We do recognize that we are sometimes a little slow off the mark in developing new ideas, and we have certainly tended, as our British saying goes, to bite off more than we can chew. But though we may have exploited some of our schemes a shade tardily, we have no lack of them; and we are curbing our ambition to proper proportions.

Sometimes we are chided for our naïve notions of salesmanship and for our disinclination to follow up with after-sales service. But we honestly believe that we have learned better—and certainly we have learned quickly—in a hard school. In any case, whatever corners of our house remain to be put in order, we are not ashamed to show our guests round.

Here on the wall are two certificates of which we are especially fond: they carry the seal of the Fédération Aéronautique Internationale and credit British pilots and British aeroplanes with the world's records for speed and altitude. We are rather proud of our little library, too. Order-books are our line—the plump kind—so the book-cases are of the expanding type.

Out in the garden our Variegated Viscount and Fast-Climbing Comet are in full flower, and the Late-Blooming Britannia seems to be coming along nicely. In the dark of the potting shed are more exotic specimens, which, though they promise well, must await another year at least before we display them or even talk about them.

Except for the potting shed, then, we offer our guests the run of the place. We are delighted to have them. And so—

A greeting to all who have journeyed to be with us next week.
A wish for a clear sky over Farnborough
and a light breeze along the runway.
A hope that business and pleasure may prove compatible.

Avec nos souhaits de bienvenue à tous ceux qui ont
entrepris ce voyage pour être des nôtres la semaine prochaine.
Avec nos vœux de ciel sans nuages au-dessus de
Farnborough, et de brise légère sur la piste d'envol.
Avec nos espoirs de voir l'utile se joindre à l'agréable.

Ein Gruss, an alle, die hierher gekommen sind, um die nächste
Woche mit uns zu verbringen.
Ein Wunsch, auf einen klaren Himmel über Farnborough und eine
leichte Brise auf der Start- und Landebahn,
Die Hoffnung, dass sowohl Geschäft wie Vergnügen auf die Kosten
kommen werden.

Un saludo a todos los que han viajado
para estar con nosotros la semana próxima.
Un voto de que tengamos cielo azul en Farnborough
y una ligera brisa sobre las pistas.
Una esperanza de que resultan compatibles el negocio y el placer.

FROM ALL QUARTERS

FILL 'ER UP: A crucial moment in the triumphal, if sedate, progress of a Vertol H-21 helicopter on a 2,610-mile flight-refuelled journey from San Diego to Washington. Here the H-21 is being refuelled, by the looped-hose method, from a de Havilland Otter (U.S. Army U-1).

Britannia Proving Flights

BRISTOL BRITANNIA proving flights to Johannesburg, discontinued by B.O.A.C. in April pending engine-icing modifications, were due to be resumed last Tuesday by G-ANBC. Two other flights to Johannesburg will be made before the inaugural passenger service (now scheduled for October 1), and these are due to begin on September 3 and September 17. It is probable that a proving flight to Sydney *via* Hong Kong and Singapore will leave London on September 7.

English Electric Accelerate

DETAILS of two new supersonic tunnels for the English Electric Company were revealed this week at a meeting of AGARD in Brussels (the first such meeting at which S.B.A.C. representatives have attended). The engineer in charge of the Warton research establishment, Mr. F. E. Roe, announced that by 1958 the company's aircraft division will have a 4ft-square tunnel capable of Mach 4, and the guided weapons division an 18in-square tunnel able to reach Mach 6 (faster than any other British installation of similar size).

Both tunnels will be of the intermittent blow-down type, using a common air supply. Data recording and reduction, by Deuce computor, will be automatic and the cost is reckoned at £300,000. A model of the installation will be on the English Electric stand at the S.B.A.C. Show next week.

The Gyron Junior

JUST a year ago the de Havilland Engine Company were permitted to announce the existence of a turbojet called the Gyron Junior. Since that time security restrictions have forbidden publication of any details of this unit; in fact, it has not even been possible to confirm the fairly obvious fact that it is a scaled-down variant of the Gyron. It is now certain that the company will be permitted to display a model of this engine at the forthcoming S.B.A.C. Exhibition and we are accordingly offering a few preliminary comments.

In our "aero engines" issue of May 11 we published the following extract from an account written in the autumn of last year by an American journalist who had then just completed a tour of several British aircraft plants:

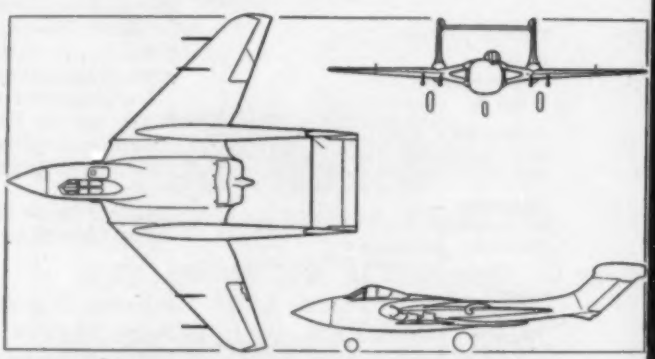
"de Havilland's pride is Gyron Junior DGJ.1, a scaled-down Gyron designed for thrusts in the 8,000 to 11,000 lb bracket. One of these engines is now (October) running on the test stand at the lower end of the design thrust range. The current weight is about 1,500 lb, a figure which should not increase to any great extent as the thrust values climb. Prospects are that the Junior will soon be announced as the highest known thrust/weight ratio turbojet, approaching a ratio better than 7 to 1. Observers see the engine as an Avon replacement. Its light weight and minute size—comparable to the Viper of 28in diameter and 66in length—fit it for a wide range of applications. Among these is installation in one of the prototype interceptors now nearing flight at Saunders-Roe and Avro."

Such an engine fills a vital gap in the available range of aircraft powerplants. It is instructive to prepare curves of thrust plotted against weight for recent designs of turbojet operating at the same turbine-inlet temperature. If this is done the Junior shows up extremely well and no other engine more vividly illustrates the progress which has been made since the first generation of axial turbojets appeared some seven years ago. The American writer's phrase "Avon replacement" may be a trifle misleading, in that the Junior is hardly likely to replace the Avon in airframes currently using the latter engine. It is, however, an obvious choice for a wide variety of future designs of aircraft, many of which would suffer serious performance penalties were any other engine to be chosen. Obvious applications for such a unit include all manner of small, high-performance aircraft, with particular emphasis on mixed-power supersonic machines in which the turbojet could well have an afterburner, probably with a convergent/divergent nozzle.

Compared with corresponding engines which have recently been designed on the Continent, the Junior is very much more powerful. This indicates that we are either going to employ one engine in types of aircraft for which the French have specified two, or, equally likely, that certain of the British aircraft which will use this engine will be rather larger and heavier than has previously been thought necessary.

Altogether the Junior should become one of the world's most important engines, and its successful—and incidentally rapid—development augurs well for the future business of de Havilland.

Examination of the Gyron Junior at Farnborough will give dramatic indication of how the technology of the turbojet is beginning to approach its limits, at least as we see them at present.



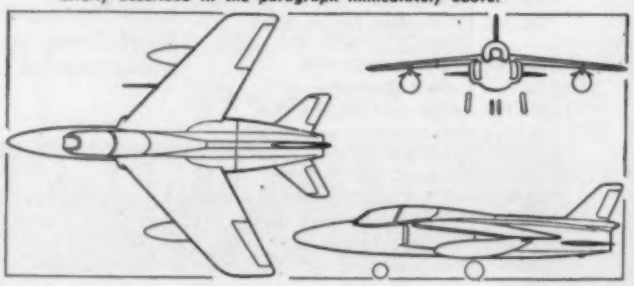
D.H.110 Mk 20: Pending allocation of a name, the foregoing is the designation of the production-type D.H.110 all-weather fighter, shown in this latest manufacturer's drawing (superseding that on page 354).

Gnat Trainer

INTENDED to serve as a single stepping-stone between *ab initio* instruction and operational flying, the two-seat Folland Gnat is shown for the first time in an accompanying three-view drawing. Basically the airframe is similar to that of the fighter, and the engine remains a Bristol Orpheus.

Major differences include a slightly longer fuselage, with a second Folland/Saab lightweight ejection seat for the instructor,

GNAT FOR TWO: General arrangement of the Folland Gnat trainer, briefly described in the paragraph immediately above.



MILITARY BRITANNIAS were the particular interest of the Secretary of State for Air, Mr. Nigel Birch, when he visited the Queen's Island works of Short Brothers and Harland, Ltd., on August 20. Here he is being conducted round the main factory by Short's chairman, Rear Admiral Sir Matthew Slattery (left).

F-100 FOR TWO: The long canopy of this North American F-100 Super Sabre proclaims it to be of the new sub-series "F," a two-seater suitable for use as a trainer or, operated as a single-seater, capable of fighter or fighter/bomber missions. Several other advanced versions of the supersonic F-100 are in prospect.

mounted behind and slightly above the pupil's seat; a revised wing, with greater area and a thickness/chord ratio of seven (instead of eight) per cent; flaps, mounted inboard, displacing the ailerons (powered, with manual reversion) to a conventional position outboard; and a modified fuel system, involving relocation of the forward fuselage tank as a result of the addition of the second seat. Performance figures are not available, but it can be stated that a 75-minute training flight can be undertaken on internal fuel, and that another hour's fuel can be carried in the pylon-mounted under-wing tanks.

Supersonic Crusading

ON August 22 it was reported by the U.S. Navy that a Chance Vought F8U-1 Crusader "probably" beat the existing speed "record" for American fighter aircraft during measured runs over the Mojave Desert in California. No precise figure for the speed reached was made public but it is generally believed to have been approximately 1,030 m.p.h. This compares with the record of 822.135 m.p.h. achieved one year ago by Col. Hanes in a North American F-100C, and with the 1,132 m.p.h. established by Peter Twiss in the Fairey Delta 2 in March. The Crusader was flown by Cdr. Robert W. Windsor and the calibrated course was at the Naval Ordnance Test Center at China Lake. Like the F-100, the F8U is powered by an afterburning Pratt and Whitney J57.

A development of the F8U will be engined by a more powerful turbojet and will introduce design improvements which should enable it to exceed the present international record held by the F.D.2. The British machine's other challenger, the Lockheed F-104, is claimed by Lockheed to be "the fastest jet aircraft in the world"; but it has yet to substantiate this claim. Meanwhile the F.D.2 itself is theoretically capable of handsomely exceeding its own record since, as we pointed out in our issue of March 23, the aircraft accelerated throughout each of its measured runs and finished each run at a speed in excess of 1,200 m.p.h.

Mercator Lost in China Sea

A U.S. NAVY P4M-1 Mercator, carrying a crew of 16, was lost during a routine flight some 400 miles north of Formosa on August 23. It was reported that the aircraft notified its base that it was under attack and a major air search was immediately instituted in the vicinity of its last known position 32 miles off the Red Chinese mainland near the Saddle Islands. The American destroyer *Dennis J. Buckley* located wreckage off the China coast about 300 miles north-east of Formosa soon afterwards. Examination showed that the aircraft had been damaged by fire, which had presumably broken out after the attack. The body of one of the crew was recovered, together with two life-rafts.

During the search Peking Radio announced that a "Chiang Kai-shek aircraft" was fired on at about the time that the American aircraft reported it was under attack. The report stated that the aircraft had intruded over Chinese islands and flew off in a south-easterly direction after being hit.

Fighter Collisions

WE regret to record the death, following a mid-air collision last Saturday, of the Gloster Aircraft Company's experimental test pilot Brian Smith. He was flying a Javelin from the airfield at Moreton Valence when he was involved in a collision with an R.A.F. Hunter. Mr. Smith, his navigator, F/L. R. Jeffries, R.A.F., and the Hunter pilot, F/L. Hicks, all used their ejector seats but, for reasons which have not so far been determined, Mr. Smith failed to save his life. He was found still in his ejector seat. F/L. Jeffries suffered a broken arm and shock and F/L. Hicks was reported to be in hospital in a serious condition. Both aircraft fell near Nailsworth, Glos, causing some damage to a farm building, but no casualties. Brian Smith had been with Glosters for over five years. He had served with the R.A.F. from 1942 to 1946, and was later in No. 501 Sqn., R.Aux.A.F., flying Spitfires and Vampires.

On the following day two Meteor 8s of an R.Aux.A.F. squadron at Biggin Hill collided over Clopton, near Woodbridge, Suffolk, and, though one pilot used his ejector seat, both lost their lives.

German Industry Orders

ORDERS for 671 military transport and training aircraft, it is reported, had already been received by the German aircraft industry before its recent revival. They are for three types of aircraft, to be built under licence from two French companies and one Italian concern by three groups of constructors.

A total of 117 Noratlas transports are due for manufacture by Flugzeugbau Nord, under licence from S.N.C.A.N.: some 360 Fouga-Magister trainers by the partnership firm of Messerschmitt

THRUSTING LANCES: Powered by the Rolls-Royce Avon RA.7 turbojet with afterburner, these Saab-32 Lansen all-weather attack aircraft of the Royal Swedish Air Force's Attack Wing F.17 make a brave—and enviable—sight.

FROM ALL QUARTERS . . .

and Heinkel; and 194 Piaggio trainers, under Italian licence, by Focke-Wulf at Bremen, jointly with Professor Blume.

This total of 671 does not include the order placed with Dorniers six months ago for 469 Do 27s, the first of which is expected to be delivered in October. The value of these 1,140 aircraft is £76m.

Orders placed with German firms are mainly for airframes only. The majority of the engines required will be bought abroad.

Submarine Flying-boat Tender

THE U.S. Navy submarine U.S.S. *Guavina*, which has been converted as a flying-boat tender, recently completed a week-long anti-submarine exercise off the coast of Florida, during which she acted as base vessel for four Martin P5M-2 Marlins.

Capable of refuelling and reloading patrol flying-boats, *Guavina* also acted as operations centre and accommodated the 12 officers and 33 enlisted men of the aircraft crews. At night the aircraft were moored in the open sea to buoys laid by the submarine. For loading operations a platform made of inflatable sealed bins was secured to the stern of the submarine. When partially filled with water the bins provided a pontoon bridge some 18in clear of the water.

An obvious advantage of this type of operation is the element of surprise that could be achieved with a combination of submarine and flying-boats if they arrived unexpectedly in an area where no base was known to exist. The presence of the submarine base could also remain hidden if the submarine submerged at all times except when actually servicing aircraft. The group could easily be moved from place to place, and no shore facilities would be required.

Topical Treatment

PUBLISHED on the eve of the Show, and intended primarily for the non-trade visitor, *Farnborough Story** begins with even more adjectives per sentence than the well-remembered Farnborough commentator's eulogy of the Princess flying-boat. But, in general, this "thrilling saga of the greatest show on earth" is soundly written.

Chapter 1 sets the scene of the Display, and is followed by descriptions of how the week is organized on the ground and in the air. Then comes a review of some of the more outstanding current British aircraft and of the jobs they are doing throughout the world: after which Chapter 5 takes the reader back 50 years to trace the history of the Royal Aircraft Establishment, which forms the backcloth to the display, and of some of its people. Finally, there is a glimpse of "The Years Ahead," complete with bedsteads, saucers and a perhaps-too-gloomy view of helicopters.

The fact that one of the co-authors is a member of an aviation accessories company may help to explain the joyous and oh-so-true account of the trials and tribulations that precede the appearance of a display stand at Farnborough. Certainly it explains the identity of the only Associate Member's stand that is illustrated.

Typical of the little snippets of information that indicate the careful research that has gone into *Farnborough Story* is that many of the more perishable items of food served in the exhibitors' restaurant are stored in one of the R.A.E.'s wind tunnels, which has a large refrigerating capacity. Co-operation indeed! And, obviously, one of the many details which help to ensure the success of "a spectacle compounded of daring imagination, years of tireless research, skilful piloting and superlative showmanship."

*"*Farnborough Story*" by Roy McLeavy and Maurice F. Allward. Fetter Publications, Ltd., 109-110 Waterloo Road, London, S.E.1. Illustrated. Price 5s.*

FILTON CHALLENGERS

THE Bristol Britannia, which has no need for modesty, has in recent weeks been going out of its way to show itself off. As recorded in *Flight* August 10, the first Series 300, from which a whole new family of faster, heavier-load Britannias will spring, made its maiden flight at the end of July. Its shapely, lengthened form is portrayed in the *Flight* air-to-air pictures, secured from a Britannia 100, on this and the opposite page.

The smaller pictures have as their common subject the tour of the U.S.A. and Canada just completed by a Series 100 aircraft, specially furnished, and painted in a striking colour scheme of white-top, blue cleat-line and fin with transverse bars in maroon.

Some 11,800 statute air miles had been covered by last Friday at an average ground speed of 320 m.p.h., and this with a series of flights that left a residual average adverse wind component of 15 m.p.h. Since leaving Vancouver (we recorded its arrival there last week) the Britannia has visited San Francisco and flown on—by way of Denver, Chicago and New York (where it gave three demonstrations)—to Miami, arriving at 2220 hr (G.M.T.) on Friday.

The occasion of the American tour evoked from Bristol, as was expected, a strong statement of the case for the turboprop. Speak-

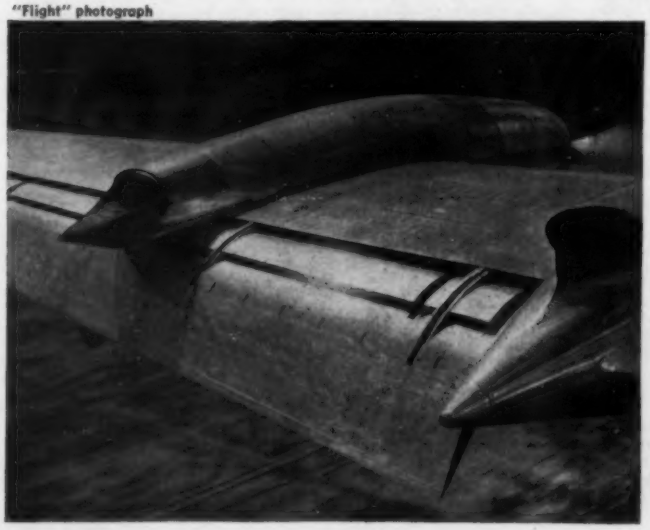
(Right) The luxurious lounge in the Britannia American-demonstrator. (Opposite page, centre) Midnight at London Airport on August 12 as the aircraft taxied out for its maiden transatlantic voyage. (Opposite, bottom right) Key men on board were Capt. A. Meagher, B.O.A.C.; Mr. Peter Masefield, managing director of Bristol Aircraft; and Bill Pegg, Bristol's chief test pilot. (Opposite, bottom left) The Filton runway races past beneath a Britannia 100 taking off to enable "Flight" to secure the fine portraits of the crimson-and-white 301 aircraft below and opposite.

"Flight" photograph

"Flight" photograph

ing at the National Turbine-Powered Air Transportation Meeting in San Diego, Mr. Peter Masefield claimed for the turboprop that "it could be operated 20 per cent cheaper than the equivalent jet aeroplane or the piston-engined job of the same size." The Britannia was reliable, the noise level was low and the passenger appeal high. In contrast, the turbojet faced particular problems, which would be overcome "in a greater or lesser degree and in longer or shorter time." Added Mr. Masefield: "Meanwhile the turboprop is here, it is flying—it is the Britannia." And to spice his remarks, he injected into his speech the revelation that deliveries against orders placed now could be made next year—previously the earliest delivery date quoted has been February, 1958.

"Flight" photograph



CIVIL AVIATION

Two representatives of the C.A.A. were at Hatfield from August 20 to August 22 for preliminary discussions on U.S. certification of the Comet 4s and 4As ordered by Capital Airlines. This picture, taken beside D.H.'s Leonides-powered Beaver before the visitors departed on other business, shows (left to right), Mr. R. B. Maloy of C.A.A.'s Paris office; Mr. S. Rolle, powerplant specialist from Washington; and Mr. A. G. Peters, D.H. assistant chief designer.

POSTSCRIPT TO B.E.A.'s REPORT

A CLOSER scrutiny of B.E.A.'s 1955-56 report, the typically comprehensive and detailed contents of which were summarized in these columns last week, reveals two points of particular—and inter-related—significance. The first is that, of all the 101 fixed-wing aircraft in the fleet, only the Viscounts made a profit (£1,138,605). Losses incurred by the other types were: Elizabethan, £558,721; DC-3 Pionair, £722,195; Islander Rapide, £30,861; and Hebrides Heron, £21,156.

The second point is that B.E.A. is still not 100 per cent sound on the primary business of flying operations, *traffic* revenue being short of total expenditure by £143,849. This amount was appreciably less than the comparative figure for last year (£483,814); but the net profit of £603,614 was still achieved by "other revenue" (mostly ticket commissions) amounting to £747,463.

Thus B.E.A. continues to be dependent on non-flying revenue to tip the balance towards profit. The obvious reason is the loss still incurred by every aircraft except the Viscount: a loss that emphasizes B.E.A.'s need for suitable replacements. The larger Viscount 802 will be more economic than the 701 over Elizabethan stages (346 st. miles average), but it is doubtful whether either Elizabethans or 701s could make a profit out of the 162 st. mile average of the DC-3 Pionairs' routes, even assuming they could be spared for such work. So far as Rapide and Heron types of service are concerned, it is probable that by their very nature these will always be marginal operations.

At the news conference held in London on the eve of the report's publication on August 22, Lord Douglas, in answering questions, said a good deal about B.E.A.'s future plans. The essence of his remarks was as follows:—

(1) A "very intensive study" of suitable jets for longer routes was being made and it was possible that they would be in service in the early sixties. A small number only would be needed, and B.E.A. preferred to avoid introducing a new type. The Comet 4A was a possibility, although American projects would be studied to see what "tips" might be picked up. (2) B.E.A.'s share of Continental traffic was now 56 per cent against 17 competing airlines, compared with 48 per cent in 1952-53 against 12 airlines. (3) All 24 Viscounts 802s would be delivered by next summer. First 802 service (in December) would be to Paris, and these aircraft would eventually serve Glasgow, Belfast, Berlin, Hamburg, Amsterdam, Dusseldorf, Frankfurt, Zurich, Geneva and Basle. (4) The smallest economic size of helicopter, in B.E.A.'s view, was a 40-50-seater, and Lord Douglas hoped that rumours that the Rotodyne was to be discontinued were not true. (5) B.E.A. services to Dublin are scheduled to begin on April 1 next. (6) The Twin Pioneer might not be an economic proposition for the Highland services, although it would be "ideal" for Land's End-Scillies. (7) A third airport for London might be necessary in the late sixties. (8) Eighty per cent of B.E.A.'s London departure delays before Easter were due to road congestion between Waterloo and London Airport. (9) Increase in B.E.A.'s revenue during the first months of the current financial year had not been up to expectations, owing to the general economic situation: "We had budgeted for a profit of £750,000, but we are not quite making it." (10) A B.E.A. service to Belgrade was expected to start next spring.

A.W.A.'s NEW TRANSPORT

A NEW venture by Sir W. G. Armstrong Whitworth Aircraft is the production of a turboprop passenger-freighter aircraft, details of which are due to be revealed at the S.B.A.C. Display. The project represents the first excursion by this company into the civil field since the Mamba-powered Apollo of 1949. Mr. Woodhams, A.W.A.'s managing director, is reported to have said: "We have already had a number of enquiries about it, and it will provide full employment for our workers for some time."

I.F.A.L.P.A.'s DEADLOCK

THE International Federation of Air Line Pilots' Associations has made public copies of nine letters exchanged between the Federation and the Ministry of Transport and Civil Aviation concerning the take-off accident to the C.P.A.L. Comet 1A, CF-CUN, at Karachi on March 3, 1953. This accident, it will be recalled, was attributed to pilot-error. I.F.A.L.P.A. contends that not all the evidence relevant to the accident has been made available; and the unsuccessful exchange of correspondence seeking this evidence from one of the authorities which participated in the inquiry has been made public by the Federation as "the only [course] left open to us."

The evidence sought by I.F.A.L.P.A., and which de Havilland (through the M.T.C.A.) have declined to release to the Federation, is the stalling speed of the Comet 1A in the conditions of weight, temperature and humidity prevailing at the time of the accident, and in the light of subsequent knowledge of the adverse influence of ground effect on the stalling speed of the Comet 1A. It is possible, says I.F.A.L.P.A., that the Karachi Comet was "scheduled to unstick at one or two knots above *or below* the stall."

I.F.A.L.P.A. feel that an injustice may have been done to the pilot (Capt. C. H. Pentland who, together with ten others on board, was killed), and also to the pilot (Capt. R. E. H. Foote) of the B.O.A.C. Comet 1 G-ALYZ which crashed—without loss of life—while taking off at Rome on October 26, 1952.

It is appropriate here to note a new "take-off" paragraph in the proposed U.K. revisions to the Annex 8 performance section of *International Standards and Recommended Practices*. Briefly, this recommends that no attempt shall be made to take off until a speed of 1.15 times minimum unstick speed is reached (or 1.07 with engine-cut). The margins "may be reduced" to 1.1 or 1.05 respectively "when the limitation is due to undercarriage geometry and not to ground-stalling characteristics."

SHELL AND THE FRIENDSHIP

THE prototype Fokker Friendship was recently flown by G/C. Douglas Bader, manager of the Shell Petroleum Company's aircraft department. Our correspondent in Holland reports that G/C. Bader said that Shell might buy two Friendships for the Shell fleet and that they would be used in the Persian Gulf area. The oil company's fleet at present includes the following types: DC-3, Catalina, Mallard, Goose, Sealand, Prince, Dove, Heron, Gemini, and S-55.

Sabena is reported also to be interested in the Fokker Friendship, for use on its Belgian Congo routes. A new order from an Italian company (as yet unnamed) for an executive Friendship brings the Fokker order-book to 17 aircraft definitely sold; Fairchild's order-book now accounts for 25 licence-built Friendships.

HOW I.A.T.A. FLEW IN 1955

WE referred last week to M. Gilbert Perier's article in the Summer 1956 edition of the I.A.T.A. *Bulletin*, showing the average rate of growth of world airline traffic to be 16-18 per cent annually. The same document publishes statistics of its 73 member-airlines, which we reproduce below. The growth of international traffic by 19 per cent was slightly greater than domestic traffic. The rapid increase in total passengers carried has very largely been met by the introduction of larger aircraft—indeed, the size of the world's fleets has grown only very slowly during the past five years.

SCHEDULED* OPERATING STATISTICS, I.A.T.A. MEMBERS, 1955

	International services	Domestic services	All services	Per cent increase over 1954
Revenue st. miles flown ...	340,000	760,000	1,100,000	11.1
Revenue hours flown ...	1,555,000	3,679,000	5,234,000	8.4
Revenue passengers carried	9,350,000	42,411,000	51,721,000	16.6
Revenue passenger st. miles flown	9,600,000	23,800,000	33,400,000	17.4
Available seat-miles ...	16,200,000	36,800,000	53,000,000	14.8
Revenue passenger load-factor (per cent)... ...	60.5	64.5	63.3	2.3
Revenue long-ton st. miles performed	1,200,000	2,500,000	3,700,000	15.6
Available long-ton st. miles	2,000,000	4,170,000	6,170,000	15.5
Revenue weight load-factor (per cent)...	60.1	59.1	59.5	0.2
Number of employees (at end of calendar year) ...			274,000	8.5
Operating fleet (at end of calendar year)			2,580	2.6

* Non-scheduled flights and non-revenue hours flown have not been included in this summary.

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BREVITIES

MR. G. H. WAUGH, who has represented de Havilland, Vickers and Rolls-Royce in W. Germany, will cease to represent de Havilland there as from September 1. This is because Vickers and de Havilland interests in that country—respectively Vanguard and Comet 4A—have become competitive. Mr. Waugh continues to serve Vickers and Rolls-Royce and, say de Havilland, the arrangement under which he has served all three companies has been "a happy one throughout."

* * *

"Magnetronic Reservisor" is the name given by American Airlines to its new electronic device for handling seat-reservations.

* * *

Air transport movements at U.K. aerodromes in June numbered 32,800, a 9 per cent increase on the June 1955 figure.

* * *

Warsaw Radio reports that Poland has concluded air agreements with Belgium, Sweden, Yugoslavia and Austria, and hopes soon to sign similar agreements with the U.K. and France.

* * *

Helicopter Air Service of Chicago marked the completion of its first seven years with a change of name. Henceforth it will be known as Chicago Helicopter Airways.

* * *

It is reported that Swissair may buy more DC-8s. The company's future plans include a new route to Tokyo, an extension to Buenos Aires of the present line to Brazil, and possibly a new service to South Africa.

* * *

Washington Radio reports that the U.S.-Soviet interline talks seemed to have "hit the rocks" so far as a direct PanAm service to Moscow is concerned. A PanAm-Aeroflot change-over in East Berlin is still, it was reported, being discussed.

* * *

Convair have dropped the name Golden Arrow for their new medium jet-airliner project, which now becomes known as the Convair 880. The reason is that Continental Air Lines had already announced "Golden Arrow" DC-7B services to start next year.

Bristol Aircraft have formed a new department to specialize in the interior furnishing of the Britannia.

* * *

The Boeing 707 is to be fitted with the Bendix automatic flight control system.

* * *

A ten-day conference on air traffic control in South East Asia, organized by I.C.A.O., has just been concluded in Bangkok.

* * *

Lufthansa's twice-weekly Super-G service to the Middle East will start on September 12.

* * *

It is reported from Geneva—where both Boeing and Douglas have offices—that B.O.A.C.'s order for American jet airliners will be announced on September 30.

* * *

Indian Airlines have announced a repeat-order for the Viscount; five more aircraft (presumably, like the five already on order, 768Ds) will be delivered "early in 1958."

* * *

Another executive Fairchild Friendship (Fokker licence) has been ordered, following General Tire's recent contract for an executive version. The new customer is the Continental Can Company.

* * *

The long-awaited C.A.B. decision on the prized New York-Miami route has now been made. Permission has been granted to Northeast to operate the route with National and Eastern, to give this airline a chance to function without Government subsidy.

* * *

The M.T.C.A. has revised visual flight rules so that all aircraft flying in controlled air space or 3,000ft outside will be obliged to remain at least one nautical mile horizontally from cloud, and 1,000ft vertically from cloud, in visibilities of at least five nautical miles. Outside controlled air-space below 3,000ft the requirement remains the same, i.e. aircraft must stay clear of cloud and be in sight of the ground in all weathers.

CLUB AND GLIDING NEWS

SUMMER Convention of the Association of British Aero Clubs will be held at Elstree Aerodrome tomorrow (Saturday, September 1). Members of all flying clubs are invited, whether they arrive by air or road—preferably, of course, the former. The main idea is for people to get together and talk about aeroplanes, particularly small ones, and there will be a time-of-arrival competition (between 2 and 2.45 p.m.) and an evening barbecue.

Also scheduled is the first flying meeting of the Tiger Club, which will take place during the afternoon. The Tiger Club was formed earlier this year by Norman Jones, its aim being primarily "to provide the means of meeting for those who take an active part in Tiger Moth racing and aerobatics and to organize an annual dinner, and any other functions which may be thought useful." Other founder-members are E. A. Wren, Peter Vanneck, Jack Denyer, Beverley Snook, Basil Maile and J. M. Donald, whilst C. Nepean Bishop of the Surrey Flying Club is honorary secretary. "Bish" tells us that all who fly Tiger Moths, for business or pleasure, or both, will be very welcome at tomorrow's party.

FOLLOWING the success of the Cambridge Private Flying Group's aerial treasure-hunt last year, the group held a similar event at Marshall's Airport last month. Entries included representatives of the newly formed Hertfordshire Police Flying Group, and of the U.S.A.F. club which operates from Cambridge. The treasure hunt was won by Mr. and Mrs. Norman Whisler.

A contest calling for accurate flying was the "perfect circuit" event, in which performances were marked by the instructors on no fewer than 73 items. Of the three sections for P.P.L. holders, student pilots (solo) and *ab initios*, the first two were won by John Bingham and Robert Childs respectively, while Don Pearson and James Smith tied for first place in the third category.

The presentation of trophies to the winners was made by the chairman of the group, F/L. J. T. R. Taylor, D.F.C. A shield presented by Capt. A. C. Taylor, M.A., T.D., president, to the member making the greatest all-round contribution to the well-being of the group, went to Don Jackson, the treasurer.

THE Rodman (senior) and Pemberton (junior) landing competitions of the Lancashire Aero Club will be held at Barton on Saturday, September 8, which is also the final date for the club's Crossley navigation competition.

FAIR OAKS Aero Club are organizing a lunch patrol for Sunday, September 16, which will be followed by a navigation competition for the Fair Oaks Cup. The aerodrome will be defended between 11.45 and 12.15; attacking aircraft should approach between 1,000 and 2,000ft between one and three miles away. Visiting pilots should notify Fair Oaks by September 9 so that lunch arrangements can be made. Paid flying hours for last month at Fair Oaks totalled 564.

Series production of Ifjusag two-seater sailplanes at the Alag central experimental factory, Hungary. Sailplanes produced at this factory have recently been exported to East Germany and Belgium.

HERE AND THERE

Matador Wing

THE formation of a tactical guided missile wing equipped with Martin TM-61 Matadors is announced by U.S.A.F.E. Headquarters at Wiesbaden, Germany. It is presumed that the wing will be formed from the Matador squadrons already operational in Germany.

Piling Up Hours

AN instructor crew of the 4017th Combat Training Squadron of the 93rd Bomb Wing, U.S.A.F., at Castle A.F.B., California, has become the first to pass the 500-hr mark in a B-52 combat wing. The crew consists of a pilot instructor, an observer instructor and a gunner instructor, each of whom has a distinguished record of service with tanker and combat units of Strategic Air Command.

FARNBOROUGH IN FULL

"Flight" next week (September 7)—the Farnborough Report Number—will contain fully illustrated descriptions of the flying and the new aircraft seen at the opening of the Show; these will be supplemented by some out-of-the-ordinary articles on other aviation activities, and by regular features.

"Flight" for September 14—the Farnborough Review Number—will include a detailed appraisal of the week's flying and technical trends, with further descriptions of the static exhibits, plus regular features and articles on other subjects.

Both issues will be priced at 1s 6d.

EVERY CONVERTIPLANE in the world known to have "converted" successfully is shown in this picture. The two machines are McDonnell XV-1s, and the specimen on the right is claimed to have set a new helicopter speed mark of 200 m.p.h. That McDonnell are not alone in the field is proved by the photograph of the Bell XV-3 at the foot of this page.

I.A.F. Visit to U.S.A.F.

THE Chief of the Air Staff of the Indian Air Force, Air Marshal S. Mukerjee, is to visit a number of U.S.A.F. bases in the United States early in September.

State Apartments

AN ex-R.A.F. Vickers Varsity has been converted at Blackbushe for the personal use of King Hussein and Queen Dina of Jordan. It has a retiring room for the queen, and a kitchen with an electric cooker and refrigerator. The cost of conversion is said to be £70,000.

Titanium Fire

FIRE destroyed a large quantity of titanium at the process plant of William Jessop and Sons, Ltd., in Sheffield last Sunday night. Jessops are one of half-a-dozen firms now producing the material in this country. Potentially valuable for aircraft construction by virtue of its high strength/weight ratio, corrosion resistance and strength at elevated temperatures, titanium demands highly specialized reduction and casting techniques.

A Journal from B.P.

A WIDE range of subjects—from the technical to the popular—and an attractive four-colour format are features of *Air BP*, a new quarterly started by the international aviation service of the British Petroleum Co., Ltd. Consultant editor is John W. R. Taylor.

"Try the stand in the far corner—they're offering senior draughtsmen £29 a week and a house."

PROGRESSIVE CONVERSION: During continued flight tests of Bell's XV-3 convertiplane, rotor-shaft forward angles of up to 15 deg have been successfully applied. Power requirements at speeds of up to 80 kt are reported to be low and autorotational descents from 500ft to have shown good power-off characteristics. Vibration is reduced by flexible rotor mountings.

Wings to Wheels

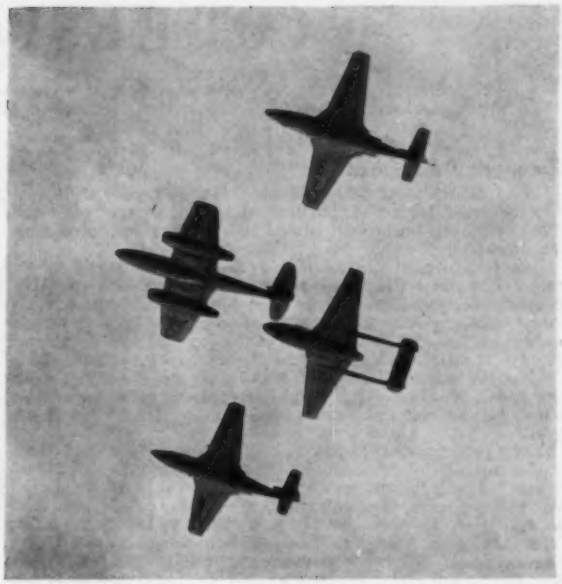
FORMERLY chief project engineer of Hawker Aircraft, Ltd., Mr. J. V. Stanbury, A.F.R.Ae.S., has joined Rolls-Royce, Ltd., as chief designer to their motor car division. Mr. Stanbury went to the Kingston-on-Thames firm in 1931, starting in their technical office with development work on the Fury and Hart. He was appointed chief project engineer at the end of the war, and has since been concerned with such famous types as the Sea Hawk and Hunter.

D.H. Engine School Moved

THE de Havilland Engine Co., Ltd., have re-established their engine instruction school at Leavesden aerodrome, near Watford. All instruction in the maintenance and overhaul of D.H. piston engines, gas turbines and rocket motors is now given there instead of at Hatfield.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News



A new slant in composite formations is the "box four," at right, made up of a target-towing Meteor 7 (leading), Vampire Trainer (in the box) and Sea Hawks from the Naval Fighter School, Lossiemouth, Morayshire. All Fleet Air Arm fighter pilots receive their operational training at "Lossie."

R.A.F. at S.B.A.C. Show

AS was the case last year, the R.A.F. will take part in the S.B.A.C. Show at Farnborough, but, because of "heavy commitments elsewhere," details of participation have not yet been completed. One of Fighter Command's Hunter aerobatic teams can be reckoned a strong probability, together with a fly-past.

S.A.S.O. with S.A.C.

AT the invitation of the U.S.A.F.'s Strategic Air Command, A.V-M. S. O. Bufton, S.A.S.O. at H.Q. Bomber Command, flew in a Valiant to America last week to observe the American Command's bombing competitions at Lockbourne, Ohio.

Hospital Landing Sites

FOUR landing sites are being selected in Cornwall so that the R.A.F. rescue helicopters based in the area can take casualties direct to hospital. The sites will be close to the Royal Cornwall Infirmary, Truro, the Camborne-Redruth Hospital, the West Cornwall Hospital, Penzance, and the Falmouth Hospital.

Though originally intended to serve aircrews who had come down in the sea, the service has been increasingly used to rescue civilians in difficulties at sea and on rocks. Previously, rescued people had first to be taken to an airfield and transferred to hospital by ambulance.

R.A.F.A. Motor Club Rally

THE R.A.F.A. Motor Club and the Per Ardua Motor Club are holding the second Battle of Britain motor rally in North and Central Wales during the night of September 8 and 9. The competitions will be run under the International Sporting Code of the F.I.A. and the General Competition Rules of the R.A.C. Nine awards will be made in five classes. Entries should be sent to K. B. Picknett, Alton House, Shrewsbury Road, Birkenhead, Cheshire.

43 Years Old

A SERVICE of re-dedication was held at Fassberg, Germany, recently to mark the 43rd birthday of No. 5 Sqn. The unit was formed in 1913 and fought with the Canadian Corps, whence originated the maple leaf in the unit's badge. For 33 years after World War I it was based mainly outside Europe, in India and Burma. The present C.O. is S/L. T. P. Fargher.

Kentish Associations

RECENTLY No. 500 (County of Kent) Sqn., R.Aux.A.F., received the freedom of Maidstone. The Prime Minister presented to it the Esher trophy as the most efficient squadron in the R.Aux.A.F. Now it has revived its pre-war custom of calling each of its aircraft after a Kentish town. Twelve names have been chosen, and the leading aircraft in the fly-past marking the presentation of the freedom was to be called Maidstone.

No. 500 now claims to be the only R.A.F. squadron to have individually named aircraft. In the squadron markings of white-outlined green zig-zag on a blue ground, the blue represents the sea, the green the fields of Kent and the white the cliffs of Dover.

Iraq Tie

AS a result of last year's Anglo-Iraqi Agreement the R.A.F. formation known as British Forces in Iraq ceased to exist from May this year. For the benefit of those who served in this formation during the many years of its existence a tie depicting an Assyrian Bull, badge of the B.F.I., on a dark blue background has been designed. Any officer or airman who served with the formation before May 1955 is entitled to purchase this tie from Messrs. T. M. Lewis and Sons, Ltd., 103 Jermyn Street, London, S.W.1, at prices ranging from 13s 6d to 22s.

R.C.A.F. in Europe

AFTER commanding the R.C.A.F.'s No. 1 Fighter Wing, first at North Luffenham, Rutland, and then at Marville, France, since August 1953, G/C. J. D. Somerville has been posted to command R.C.A.F. Macdonald, Manitoba. He is being replaced by G/C. D. J. Williams, R.C.A.F., who has for some months been on flying duties with the R.C.A.F.'s 1st Air Division in France.

G/C. A. D. Groom

WHILE flying a Vampire from R.A.F. Hawarden to Llanbedr on Thursday of last week, G/C. A. D. Groom, acting A.O.C. of No. 63 Group, lost his life. The wreckage of the aircraft was found by a R.A.F. rescue helicopter near Capel Celyn.

Over twenty years' work has gone to the making of this collection of over 500 1/72nd-scale models which was recently exhibited at Torquay in aid of S.S.A.F.A. Every model was made by Mr. Peter Farrar of Torquay.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Rotodyne Performance

I WAS interested in the report on the Fairey Rotodyne in your issue dated August 17, but I cannot accept without comment some of the statements in your leader regarding this interesting machine.

You write that ". . . its direct operating costs should match those of the best fixed-wing aircraft." May I point out that a properly designed short-range fixed-wing aircraft can achieve direct operating costs in the region of 1d per seat-mile on ranges in the region of 300-400 miles, rising to 1½d at 100 miles? Faireys themselves, according to the descriptive article, claim 2.8d at 100 miles and 2.4d at 300 miles for the Rotodyne. I do not know, of course, what utilization Faireys are using in their sums, but my own calculations are based upon 3,000 hours per year.

Later you state that "Four such vehicles could handle all present traffic carried by public transport between London and Edinburgh." If this is true, so, surely, could the existing Viscount or Ambassador series. The difficulty is to persuade people to fly and, by and large, the only sure way to do this is to reduce the fares. You continue, "They could do startling things on the cross-channel routes with either passengers or vehicles." So far as I can see, the Bristol Freighter carries about the same payload at the same speed with about half the power and fuel and with considerably less complicated engineering to maintain.

For your "airfield-starved islands," I agree that the Rotodyne could be very useful but, if it is merely vertical take-off and landing that are wanted as opposed to fairly prolonged hovering, I wonder whether a simple, fast aeroplane fitted with jet lift (*à la* bedstead) might not prove to be a lot less complicated and expensive.

Faireys' idea for a rotor having the same life as the rest of the airframe is highly commendable; it touches the rawest spot in the helicopter's hide. I wonder, however, if it can really be done without a hideous weight-penalty. This would not matter, of course, on the sort of job for which the helicopter is ideally suited, but it might be economically disastrous for commercial transport work.

Belfast. SLIPSTICK.

[The author of our Rotodyne description comments: "Slipstick" is overlooking the fact that this aircraft promises to offer an exceptional *combination* of virtues. His figure of 1½d per seat-mile has not yet been achieved by any operator of 100-mile stages, even with Dakotas purchased at knock-down prices; it certainly would not be achieved by a jet-lift machine. With regard to the Edinburgh and Channel operations, an advantage of the Rotodyne would be its ability to fly direct from city centres or, if need be, from fields (as distinct from airfields) on the coast. Another point is that a steel rotor need not carry any weight penalty.—ED.]

Numerical Superiority

WE British are noted, among other things, for our illogical system of weights and measures, and for the complexities of our coinage. Being a tolerant race we do not object when more enlightened peoples point out these and other anomalies in our way of life, but secretly we feel £ s d, in ft yd, oz lb cwt have an antique respectability that these jumped-up metrics lack. In any case, there are 10 florins to the pound and 100 pounds to a hundredweight (near enough anyway), so why the fuss?

We like our weights and measures as they are. Cumbrous, perhaps, but—like the nomenclature of our aircraft—somehow in keeping with the best national traditions. Take, for example, the Viscount. The multiplicity of its type-numbers (there are now about 50 to be memorized) is as truly impressive as the aircraft's order-book. For instance, the 771D and the 745D are not the designations allotted to the aircraft of the 71st and 45th purchasers of the 700D, which previous practice might imply, but are basically 770Ds, which in turn is basically a 700D. Again, the Britannia 314 is the designation allotted to the aircraft bought by the third purchaser of the 310 (*née* 300L.R.), although the Britannia 320 is the medium-range variant of the 310 and not the ninth customer-allocation of that type. And the 305 is not the fifth allocation of the 300, but a 302 converted more or less to 310-standard.

Let it not be forgotten, however, that Britain's first export to the U.S.A., shipped over by *Mayflower* in 1620, was our system of weights and measures. Admittedly the tons and gallons did not arrive in exactly the same condition as they were despatched; but, nevertheless, this export may have accounted for the attitude of mind which today manifests itself in a strong challenge to Britain's lead in the sphere of esoteric aeronautical nomenclature. We would do well to take careful account, for example, of America's Boeing 707, which has had a formidable array of type-numbers and names allotted to its variants—among them 717, 367-80, 120, 220, 320, KC-135, Stratoliner, and Intercontinental. Similarly, Convair's jet airliner has in turn been designated Model 22, Skylark 600, and Golden Arrow. [It is now the Convair 880—see p. 337—ED.].

The only people who do not seem to be playing the game are de Havilland. They just use 1, 2, 3, 4, etc., for each type-development, perhaps sticking on an A for each variant. Such simplicity makes things rather difficult for everyone.

Ramsgate, Kent. A. BACUS.

Sir Hazelton Nicholl: An Appreciation

From A.V-M. Sir John W. Cordingley, K.C.B., C.B.E., R.A.F. (Retd.)

THE recent death of A.V-M. Sir Hazelton Nicholl has saddened the legion of his friends in and out of the Service. No R.A.F. officer was better loved by his fellows and by his men than Sir Hazelton during his long years of duty.

How fitting that almost his last public service should have been the Controllership of the Royal Air Force Benevolent Fund, from which he retired in 1947. In that post, Sir Hazelton was able to devote himself officially to the welfare of those of whom he had been ever mindful during his life as an officer on the active list. His term of office as Controller coincided with the end of hostilities and with the beginning of the expansion of this Fund's work.

In retirement in Scotland, Sir Hazelton served as an Honorary County Representative and watched the Fund's annual expenditure on relief of distress rise to over £600,000 a year. Before he died more than £7,000,000 had been thus spent since the late Lord Trenchard founded the charity in 1919.

If a memorial be needed to the kindest of men, this Fund can in some measure supply it.

London, W.1. J. W. CORDINGLEY,
Controller, The Royal Air Force Benevolent Fund.

Fine Figure of a Woman

IT is with some reluctance that I introduce sex into the enlightened field of technical journalism, but in your issue dated August 17, page 242, the sub-title reads "Blackburn's 'Gentle Giant' flexes his limbs." Now, by everything that is anatomical and nominal our Beverley is a girl, her limbs being long and slender, even if she displays a certain *embonpoint* elsewhere.

Your report refers to the aircraft flying "a body of troops plus a Centurion." As a Centurion of today weighs some 45 tons I assume that the writer was employing the Roman usage—a leader of one hundred men. Or perhaps he meant "Centaurus, spare, Beverleys for the use of."

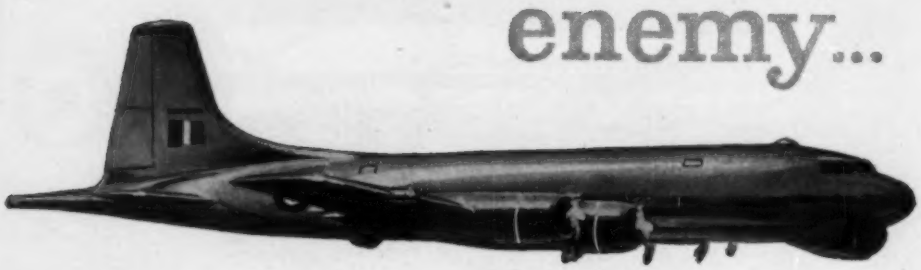
Finally, on page 264 of the same issue, the author of "Talking Points" queries the weight of a helicopter hovering inside the freight compartment of a Beverley. We have proved in theory and established in practice that the rotor downwash on the freight floor imposes a load equal to $\frac{1}{2}\rho V^2$, where V is the component of combined vertical velocity relative to the tangential axis of horizontal rotation and ρ is the technical director.

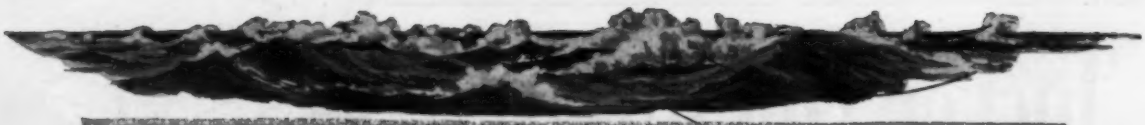
Brough, E. Yorks. M. G. K. BYRNE,
Blackburn and General Aircraft, Ltd.

FORTHCOMING EVENTS

Sept. 1. A.B.A.C.: Summer Convention, Elstree.
Sept. 3. S.L.A.E.: "Protection Against Radiation Hazards in Aviation," by W/C. G. H. Dhenin, A.F.C., G.M., B.A., M.B., B.Chir., M.R.C.S., L.R.C.P.
Sept. 3-9. S.B.A.C. Display, Farnborough ("Public" days, 7th, 8th, 9th).
Sept. 5. Kronfeld Club: "Vrsac Gliding Centre, Yugoslavia," talk by members of the Surrey Gliding Club.
Sept. 7-12. French Grand Prix, France.
Sept. 8. R.A.F. Station, Silloth: At Home.
Sept. 10-16. Battle of Britain Week.
Sept. 15. Battle of Britain Day.
Sept. 16. All Britain Model Aircraft Rally, Radlett.
Sept. 17. Aircraft Recognition Society: Lecture by Capt. O. P. Jones, O.B.E., M.V.O.
Sept. 18-21. Aero Club of Italy: International Air Week.
Sept. 19-21. R.Ae.S. and Institute of Physics: Conference, Cranfield.
Sept. 23. Air Display, Frankfurt.
Sept. 25-29. 2nd European Aeronautical Congress, Scheveningen.
Sept. 25. Society of Instrument Technology: "Accurate Calibration of Flowmeters," by E. A. Spencer, B.Sc.(Eng.), Ph.D., A.M.I.Mech.E., and A. T. J. Hayward.

To seek the hidden enemy...





Soon, the oceans around Canada will be patrolled by the first aircraft developed specifically for Canadian maritime reconnaissance duties . . . the Canadair-designed CL-28.

Developed from the Bristol Britannia class by Canadair, this is the largest aircraft ever to be manufactured in Canada and we at Canadair regard it as a tribute to our capabilities that the RCAF selected us to do the job.

Size, of course, is not the only factor, for we are equally at home in the design and production of jet fighters, training planes, airliners, guided missiles or even components for other aircraft. What counts most is our outstanding record for cost performance, on-time deliveries and quality of manufacture.

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CANADAIR HAS PRODUCED MORE JET AIRCRAFT THAN ANY OTHER CANADIAN MANUFACTURER

Tucker "Pop" Rivets

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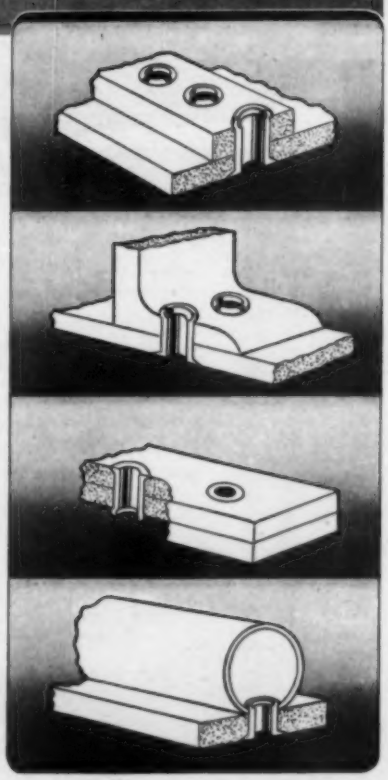
In the same way that the record breaking efficiency of the Vickers Viscount has justified the confidence of operators in all parts of the globe, so has the 'POP' Riveting system justified the confidence of Vickers-Armstrongs and the many other manufacturers who use it extensively in the assembly of their aircraft.

Requiring only one operation by one operator to set or clench the rivet, this modern system of riveting eliminates errors in setting, prevents distortion of the structure and enables rivets to be set in positions inaccessible by other methods.

See this modern system of riveting at the Exhibition of the Society of British Aircraft Constructors at Farnborough.

Stand No. 147



Photograph of 'Viscount' by permission of Vickers-Armstrongs (Aircraft) Ltd.

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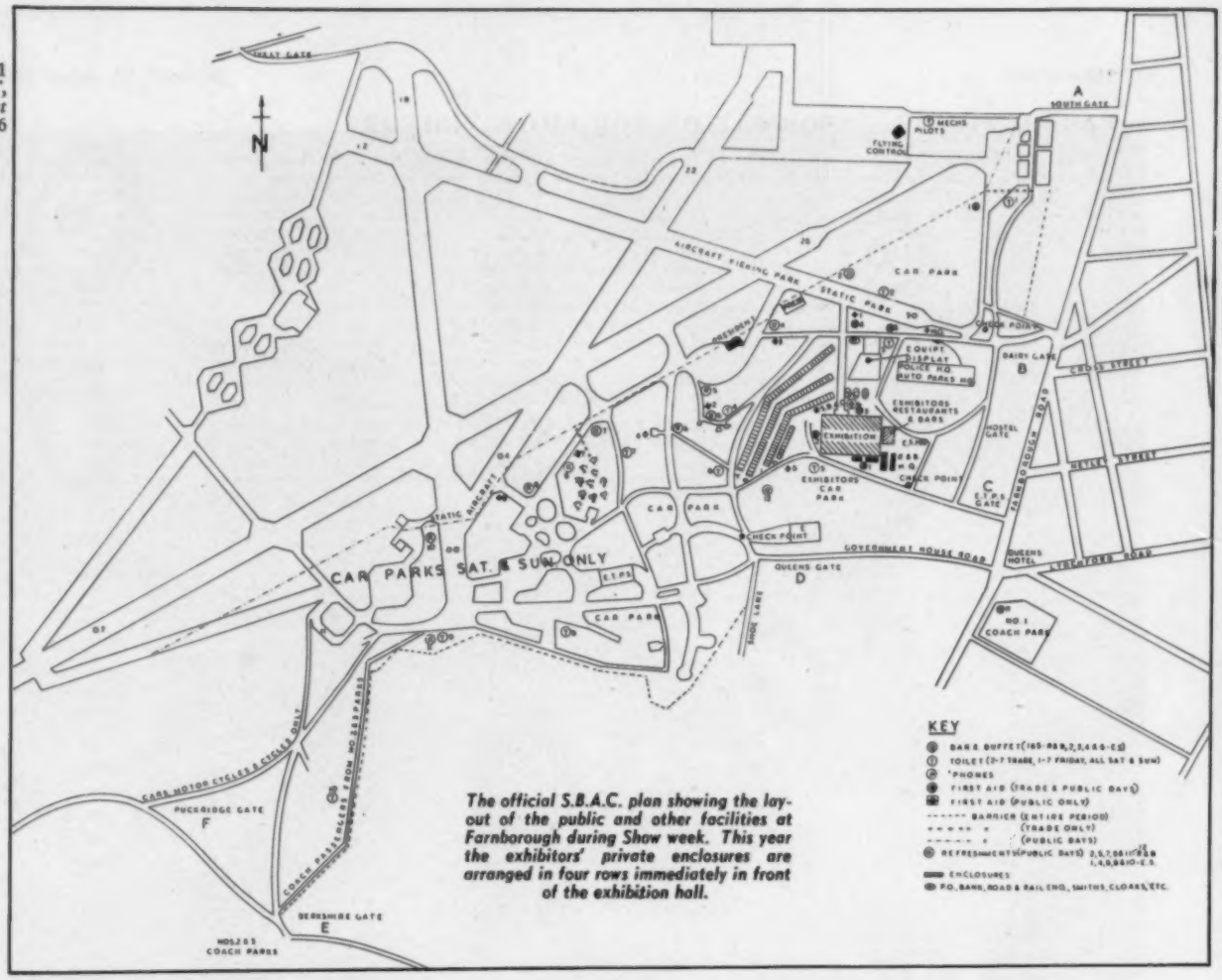


The official S.B.A.C. plan showing the layout of the public and other facilities at Farnborough during Show week. This year the exhibitors' private enclosures are arranged in four rows immediately in front of the exhibition hall.

Farnborough : Information for Show Visitors

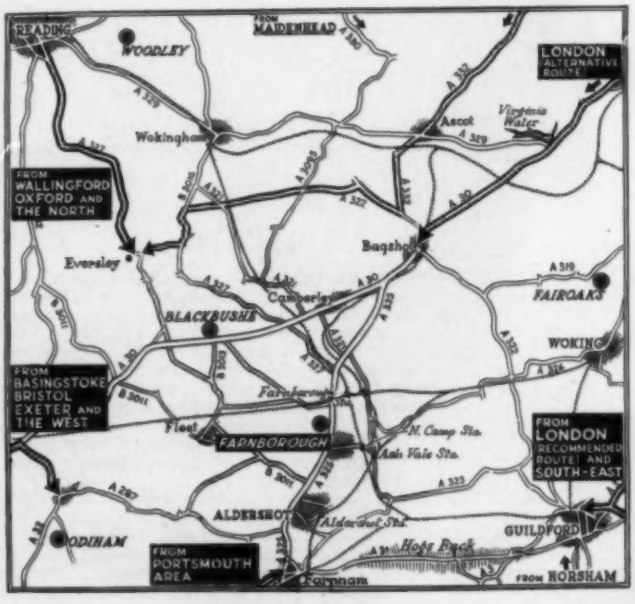
Dates, Times, Prices and Travel Facilities

THIS year's Flying Display and Exhibition of the Society of British Aircraft Constructors at Farnborough next week will, as usual, be open to the public on the three final days, Friday to Sunday, September 7-9. On the opening day, Monday, admission will be confined to technicians from the aircraft industry, and on the three following days to visitors with special invitations.

On the public days the gates open at 10 a.m., and the flying display begins at 3 p.m. This year each afternoon's flying is to be divided into five phases, during three of which an assortment of aircraft will be in the air simultaneously, for between four and seven minutes in each case. The opening item will be a spectacular demonstration of the trooping capabilities of the Blackburn Beverley. There will, of course, be individual displays of selected aircraft, and, again as usual, a number of aircraft will be available for inspection on the ground.

Admission prices for Friday, the public première, are: adults, £1; children under 14, 10s; coach parking, £1; car parking (excluding occupants), £1; motor cycles, 5s; cycles, 2s 6d. On the Saturday and Sunday admission prices are: adults, 5s; children 2s 6d. Parking charges for these two days are: cars, £1 10s (including up to six occupants, excess passengers at normal fees); motor coaches, 10s; motor cycles, 2s 6d; cycles, 1s. *For Friday only*, tickets can be obtained in advance from Autoparks, Ltd., 1-31 Maclise Road, London, W.14. Tickets for Saturday and Sunday (and for Friday also) are obtainable at the gates.

The airfield is easily reached by road, and the R.A.C. is pro-



Road approaches to the airfield. From the points indicated by arrows the police-approved routes are signposted by the R.A.C.

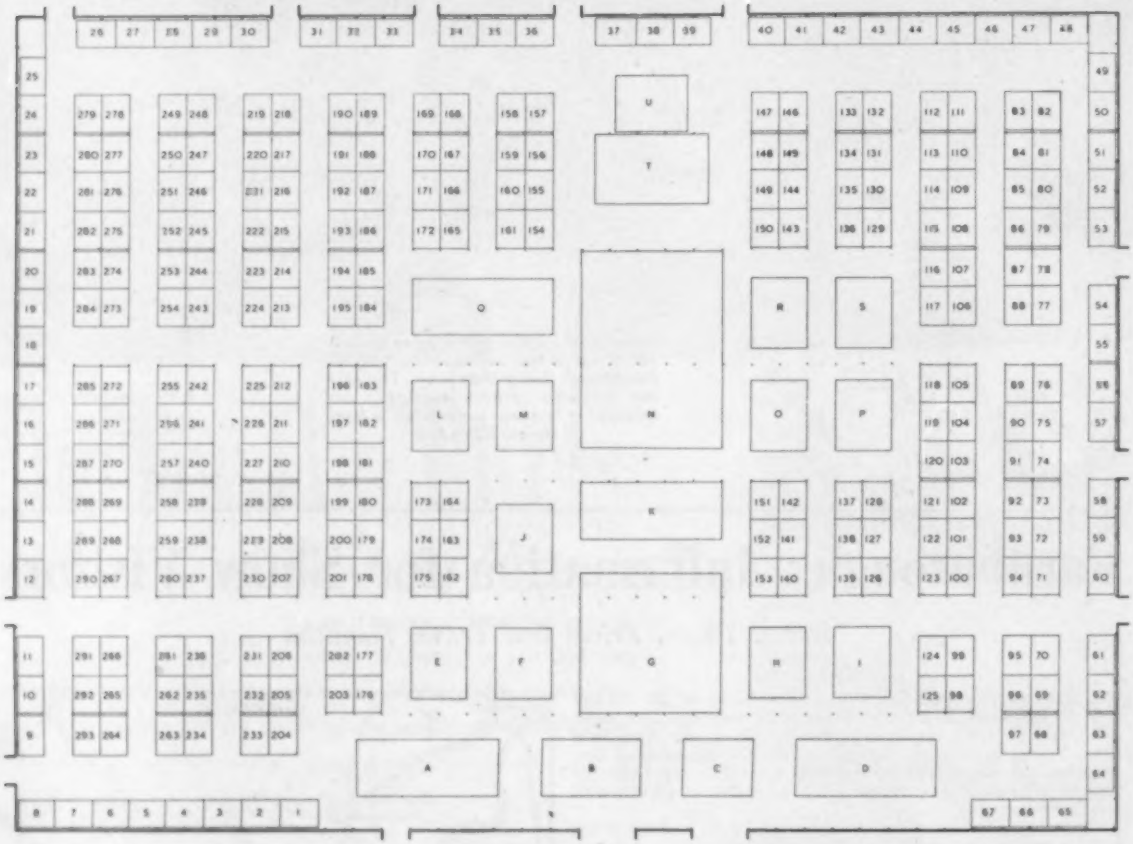
FARNBOROUGH: INFORMATION FOR SHOW VISITORS . . .

viding extensive signposting within a radius of five miles from the airfield, and also from more distant key points beyond that. As in past years, extremely heavy traffic is expected, and the R.A.C. urges motorists and motor cyclists to start early and to follow the official routes. The map on the previous page shows the principal roads to the airfield.

Comprehensive public transport facilities have been arranged for those not travelling in their own vehicles. British Railways announce that the normal half-hourly service from Waterloo to Farnborough will be reinforced as necessary on each day of the Show, and cheap day tickets will be issued from many stations, including some as far away as the West Country and the Midlands. Details are available at local stations. Return trains will be run as required. A combined rail and coach service, commencing at Waterloo, runs *via* Surbiton, Walton, Weybridge, Woking and Aldershot; tickets cost 8s 9d return. The Aldershot and District Traction Co. provide the road transport from the station, and the whole journey takes a little over an hour.

In addition to very-high-frequency services between Farnborough main station and Farnborough North Camp station and the airfield, the Aldershot and District Traction Co. run a half-hourly coach service from Victoria Station to Farnborough, with a stopping point at the airfield. Those wishing to travel by this service, says the company, are strongly advised to book their seats well in advance (bookings at Victoria Coach Station, London, S.W.1).

Layout of the Farnborough exhibition hall, commonly known as "the static show." The full list of exhibitors, with their stand numbers, appears on page 422 of this issue. "Flight" stand, un-numbered this year, is to the right of the main entrance.



THE M.o.S. AT FARNBOROUGH

STATIC exhibits from the various Ministry of Supply establishments will this year be shown both in the main exhibition hall and in the "covered equipment" section at the Farnborough Show. A working cut-away model of a N.G.T.E. ramjet will illustrate the sequence of events after launching and the method used to maintain constant airspeed. One of two stages of fuel injection is variable, so that when the fuel supply is reduced at the desired Mach number the normal shock in the intake is drawn downstream, reducing the intake pressure recovery and hence the thrust produced. The more efficient (but more complicated) method of controlling thrust by reducing propelling-nozzle throat area will also be indicated.

R.A.E. Westcott is presenting a model of a typical rocket test emplacement for engines of several thousand pounds' thrust. The test engine is mounted vertically in a steel and concrete structure, the combustion flame impinging on a water-cooled deflector, and thereafter passing into two water-cooled compartments. Observers watch through periscopes and with closed-circuit television.

The Westcott establishment is also showing the Raven solid-fuel rocket motor, which gives 11,500 lb thrust for 30 seconds and measures 16ft 10in × 17in. This type of motor was first fired at Westcott on August 3 this year and further examples are to be tested in Australia later this year. Raven will power the R.A.E. upper-atmosphere rocket to be used during the International Geophysical Year. Overall length is 25ft and, of a gross weight of 2,560 lb, the payload is 100-150 lb. A one-sixteenth-scale model of the 35-ton, 80-ft, trainable launcher will also be shown.

The Instrumentation Department of R.A.E. is displaying the camera and clock equipment used to time the Fairey F.D.2's world speed record. There will also be a short film showing rocket-engine tests at R.A.E. Westcott; and a short colour film, from the Trials Department of the R.A.E. at Aberporth, will illustrate trial guided-weapon firings. The Trials Department is also presenting a working cabinet display to demonstrate, by the firing of a small model rocket, the attitudes of a typical vehicle near the top of its trajectory.

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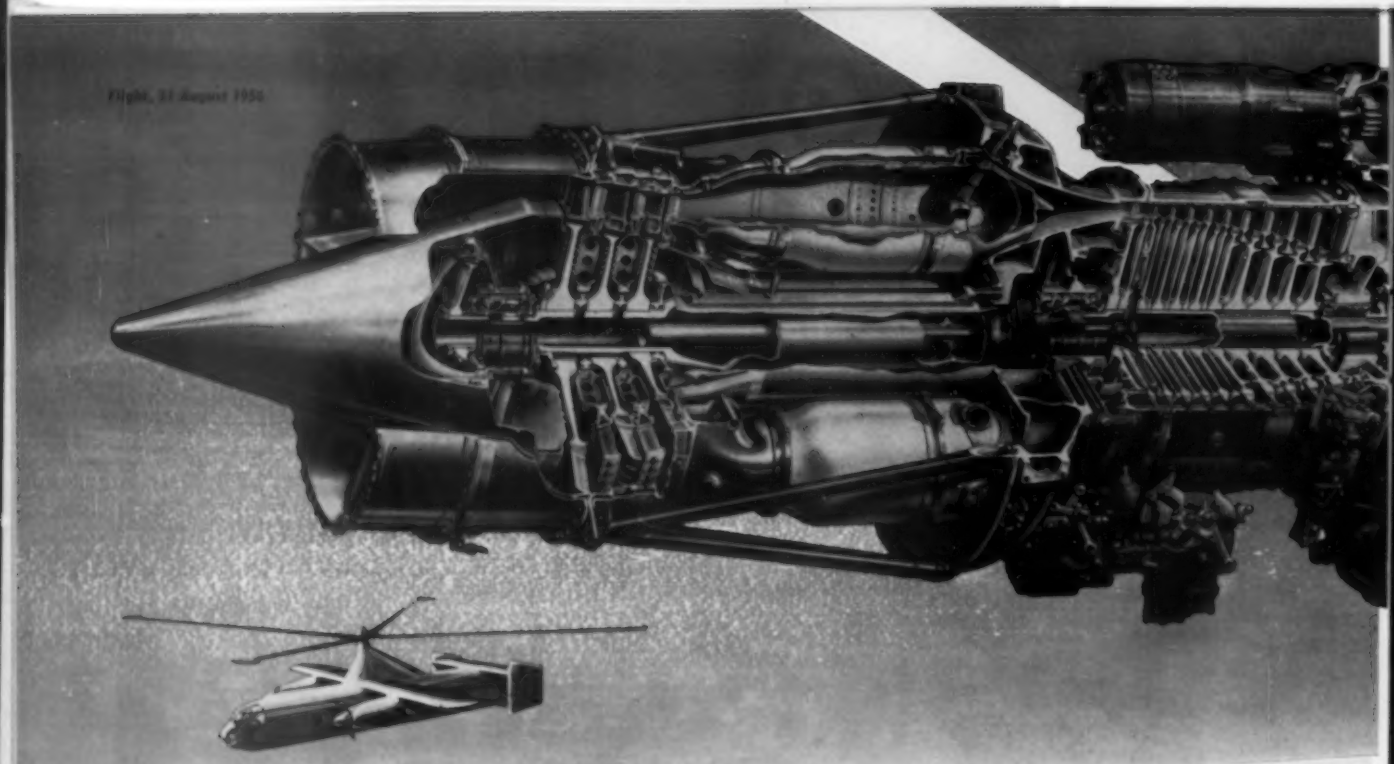
VISCOUNT
FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES
AN AIRLINE TICKET TO ROMANTIC PLACES
BEA VISCOUNT 800 OVER MAJORCA



It's Stands C & 125 for NAPIER

ELAND. Every medium-haul airline in the world is faced with an urgent decision: how, and how soon, to convert to turbo-props in the 3,000 – 4,000 e.h.p. range. The immediate and simple answer is the ELAND—single-spool, inherently safe and fundamentally economical. The *Napier Eland Convair* is a convincing illustration. It shows (1) the speed and cheapness of ELAND conversion (2) the greatly improved performance figures which result—12,880 lbs maximum payload carried 1,220 miles instead of 290 miles, 50 m.p.h. faster cruising speed—giving a greatly increased profit margin. Faster, smoother, quieter—the ELAND offers medium-haul airliners a new lease of life.

Fairey's new large transport helicopter, the Rotodyne, is to be powered in both vertical and forward flight by two ELANDS—basically similar to the standard ELAND but with an auxiliary compressor mounted co-axially at the rear.

GAZELLE. 1,260 – 2,000 s.h.p. free turbine engine for helicopters—chosen for the Royal Navy Westland "Wessex" and the R.A.F. twin-rotor Bristol 192. For ease of installation it can be mounted in any position between the vertical and horizontal. Helicopters demand tough, reliable engines: the Gazelle is designed for strenuous duty and long service between overhauls, while its outstanding simplicity means economical and speedy maintenance.

RAMJET & ROCKET ENGINES. At extreme altitudes Napier rocket engines provide the rapid acceleration, increased rate of climb and improved manoeuvrability essential for high-flying interception. Operating on liquid propellants these engines are simple, robust, high performance power units capable of repeated start-stop sequences at any altitude with complete reliability. A Napier-built ramjet test vehicle holds the British height record for such vehicles.

ORYX. The turbo-gas generator for helicopter rotor tip propulsion type tested at 780 g.h.p. and 865 g.h.p.

SPRAYMAT electrical de-icing system can be sprayed on to any contour—no matter how complex. To date Spraymat has flown well over 30 million miles in operational service.

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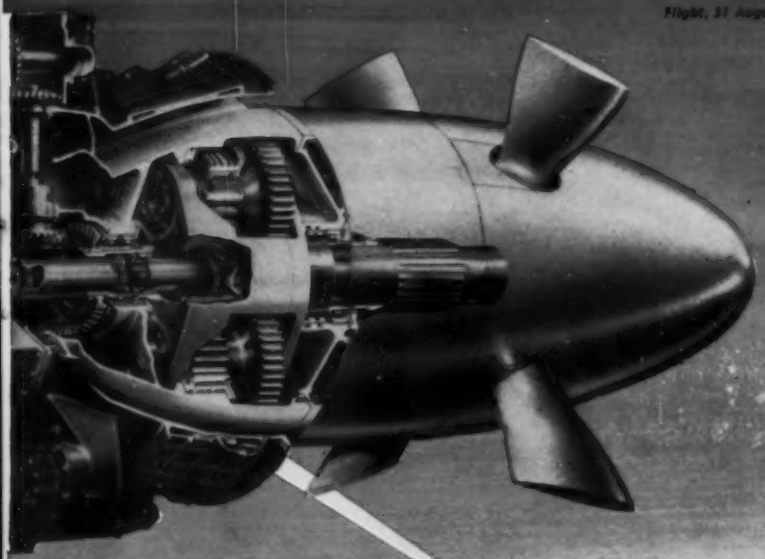

Eland turbo-prop

Gazelle free turbine engine

Ramjet & Rocket engines

Where there's an airstream... there's emergency power!

The TRA 150/2 Ram Air Turbine provides the answer to a problem which is increasingly concerning the aircraft designer. Here is a unit which will produce the power required to operate essential flying controls under emergency conditions. In such a contingency, the unit illustrated will swing out into the air stream automatically—but it is equally suitable for housing permanently within the airframe, there to be operated by a ducted air supply.

Although this unit is concerned with the production of hydraulic power, it can readily be used to drive an alternator or generator. A version incorporating a de-icing device is also under development.

The Plessey Ram Air Turbine is described and illustrated in Plessey Publication 845. Design Engineers are invited to request a copy.

AIRCRAFT AND AUTOMOTIVE GROUP · THE PLESSEY COMPANY LIMITED · ILFORD · ESSEX

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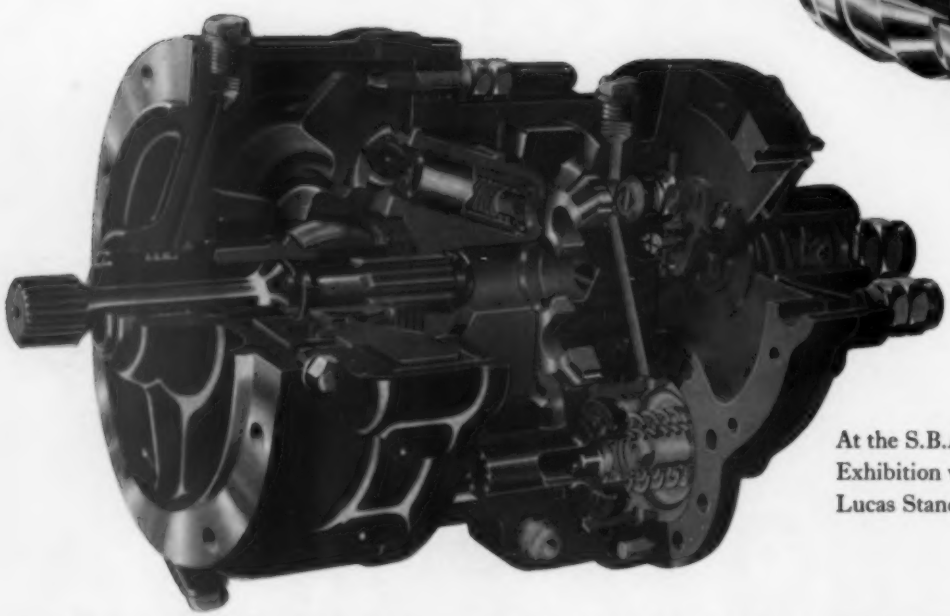

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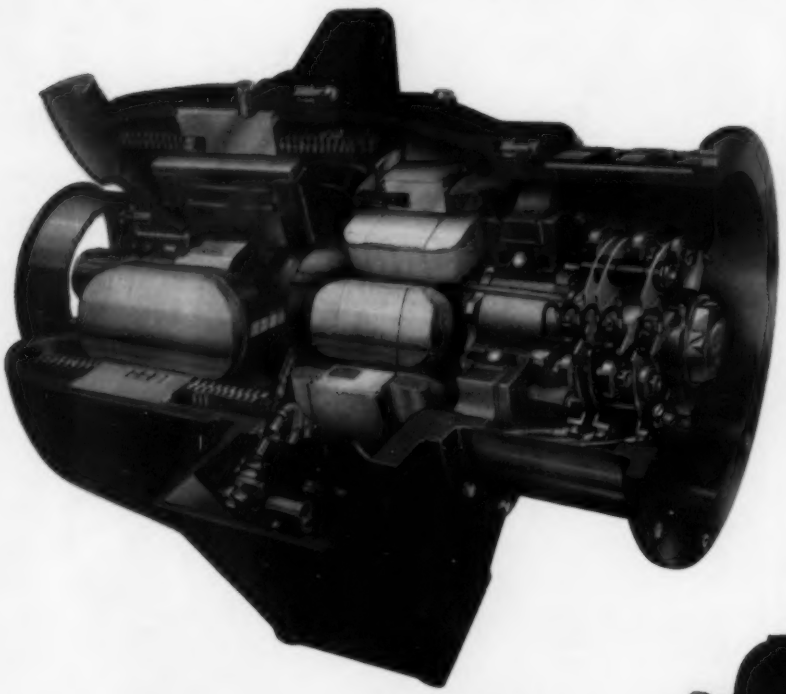

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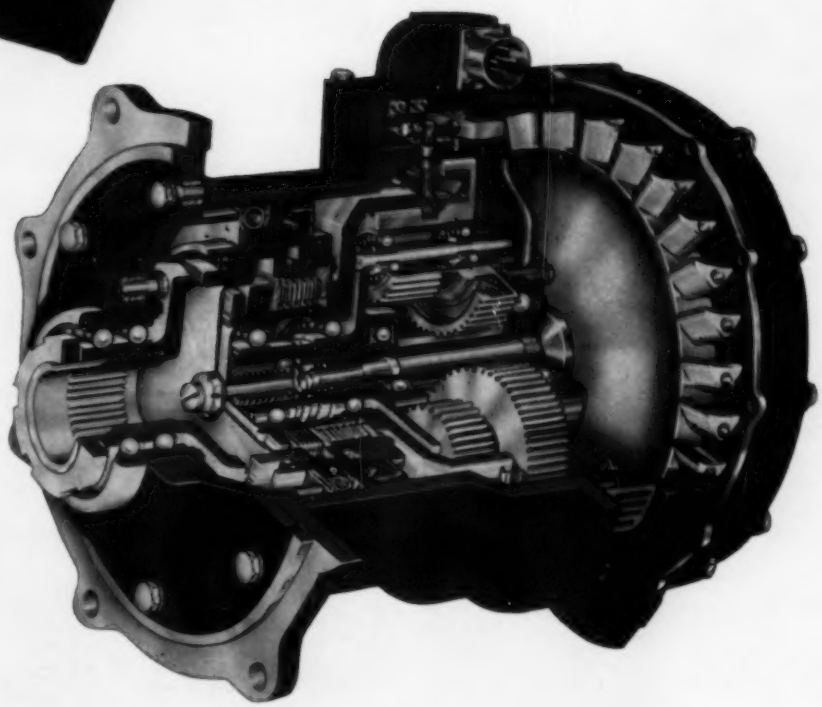

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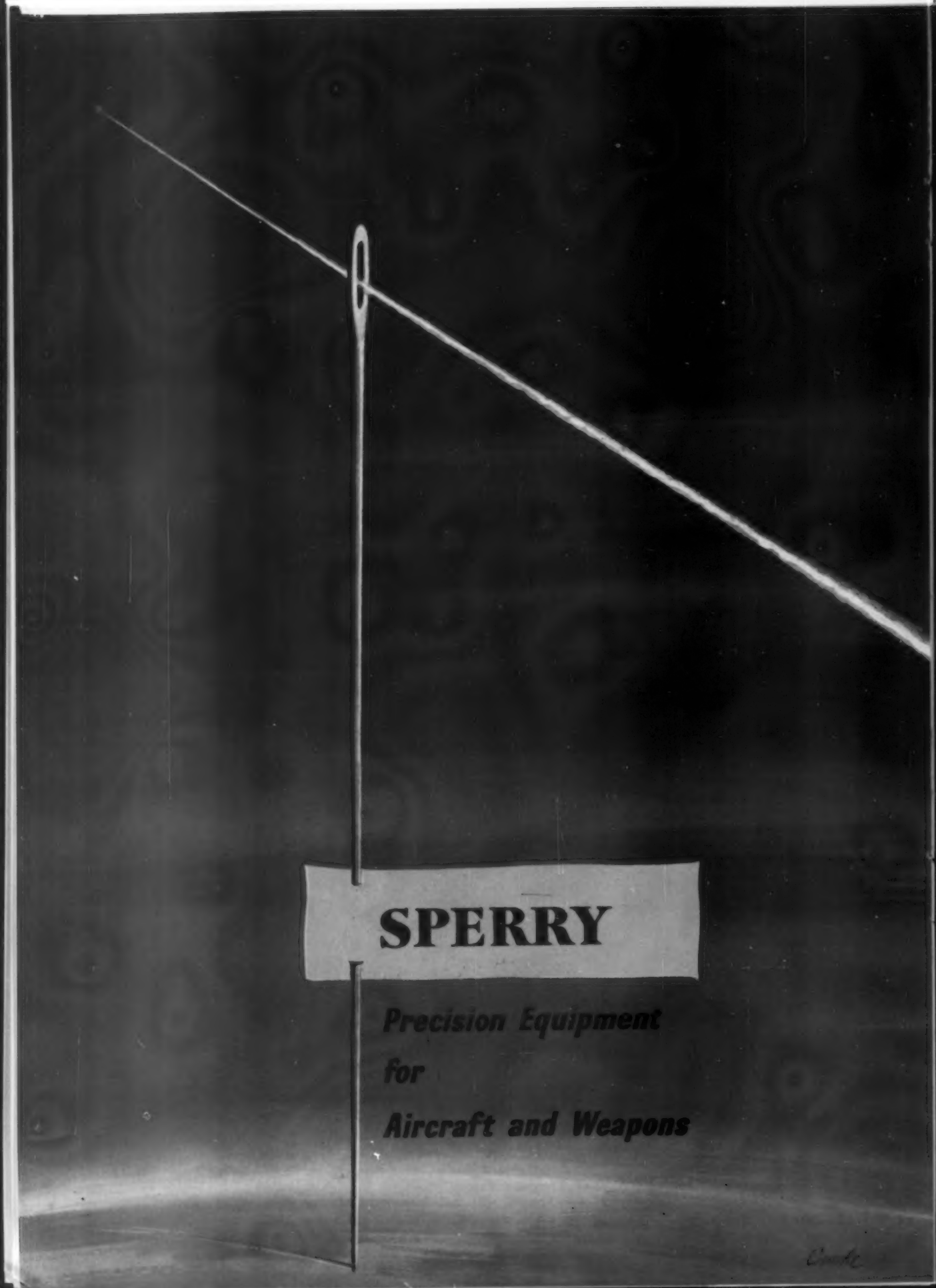
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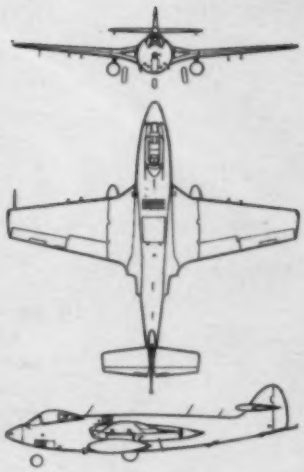
1956

IN this year 1956—the year of the 17th S.B.A.C. Display—the Fairey F.D.2 has brought home the air speed record; the D.H. Comet has won through to join the Vickers Viscount in the dollar-rich medium-transport field; the delta-winged Gloster Javelin has passed into R.A.F. service, together with the heavy-duty Blackburn Beverley transport; and the Bristol Britannia has arrived at the threshold of its commercial career. From the production lines the majority of types represented in these pages have issued forth in greater or lesser degree; but, deprived of official sponsorship, a few budding projects have withered and died. Regret or remorse at their demise is happily mitigated by the staunch private backing of such unique ventures as the Scottish Aviation Pioneers and the agricultural machines of Edgar Percival and Auster. Specific citations, however, can prove invidious, even in the best-willed industry; so we invite the reader's own appraisal of the machines upon which Britain's industrial prestige has been maintained and her business has flourished.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

Baginton, nr. Coventry. Telephone: Tollbar 2261

Sea Hawk. This Hawker-designed and Armstrong Whitworth-developed single-seater is standard equipment in all day-fighter/bomber squadrons of the Fleet Air Arm and is now in production for Holland and—to the extent of 68 machines—for the German *Luftwaffe*. The newest Fleet Air Arm variants are the F.B.5 and FGA.6, respectively counterparts of the F.B.3 and FGA.4, but presumed (in the absence of official confirmation) to have a later and more powerful mark of the Rolls-Royce Nene turbojet. The F.B.3 and FGA.4 have a built-in armament of four 20 mm British-Hispano guns and have provision for two 500 lb bombs beneath the wings, but the Mk 4 has, in addition, fittings for ten underwing rocket projectiles. Auxiliary fuel tanks are alternative stores. The FGA.4 benefits further from powered ailerons. The following is an extract from a *Flight* report on a visit to a Sea Hawk station in March this year: "Serviceability approaches 80 per cent for the new Mk 4s. Just as important a part of the working-up as the actual flying is the improvement of efficiency of the ground teams: turn-round times, refuelling plus re-arming, averaged some 30-35 min at the time of our visit, the objective being 20 min."



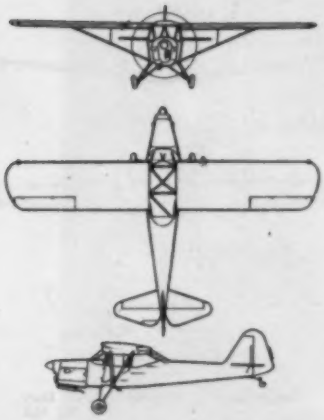
Powerplant	...	Rolls-Royce Nene
Span	...	39ft
Length	...	40ft

Above, Sea Hawk FGA.4

AUSTER AIRCRAFT, LTD.

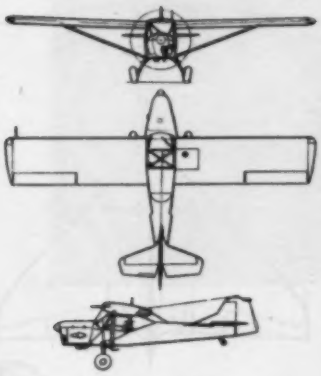
Rearsby Aerodrome, nr. Leicester. Telephone: Rearsby 321

Agricola. Designed specifically for top-dressing (aerial fertilizing) and other agricultural operations the Agricola is the outcome of a careful investigation of requirements. Alternative duties can include spraying, dusting, fence-dropping, aerial-baiting and light freighting. The makers foresee that particularly attractive innovations will be the new corrosion-resisting paints and dustproof airframe units, jointly intended to prolong operational life. The cockpit layout is simple, with only the most essential instruments fitted, and the hopper and flap controls, being power-assisted, are not tiring to operate. The field of vision



Powerplant ...	D.H. Gipsy Major 10
Span	32ft
Length	23ft 2½in
Gross weight	1,950 lb
Max. speed	127 m.p.h.

Above and centre right, Aiglet Trainer

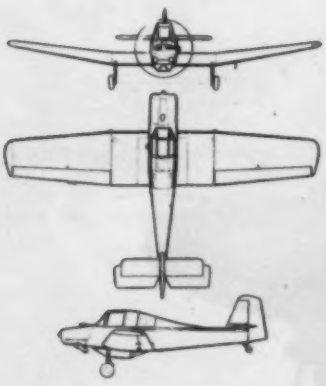


Powerplant ...	Blackburn Bombardier 203
Span	36ft 5in
Length	23ft 8¼in
Gross weight	2,125 lb
Max. speed	127 m.p.h.

Above and lower right, A.O.P.9

Powerplant ...	Continental O-470-M-2
Span	42ft
Length	28ft 1in
Gross weight	3,955 lb

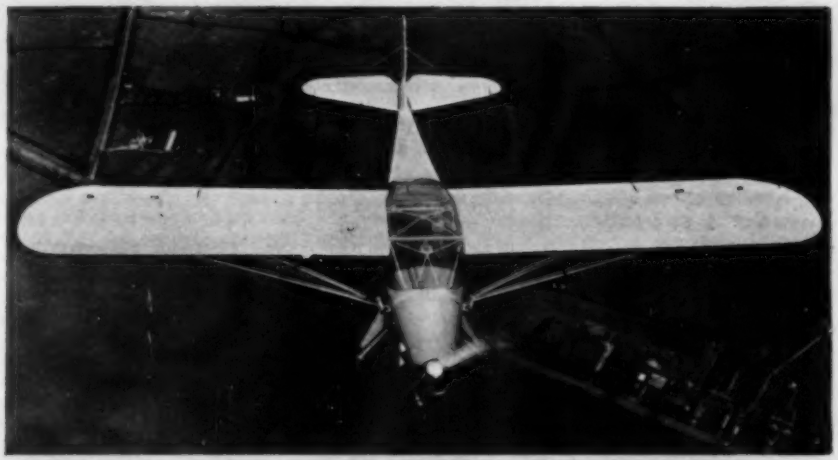
Below and left, Agricola



is exceptionally good. The 240 h.p. Continental engine has an electric starter, which is connected to a standard ground starter socket. No battery is fitted in order to save weight. For easy servicing the engine can be exposed in a matter of a few seconds by virtue of large hinged cowls. Engine cooling is entirely automatic and embodies a so-called "jet cooling" system consisting of two large ducts into which are fed the gases from the exhaust pipes. The effect is to draw engine-cooling air through the ducts and cooling therefore remains proportional to the amount of power being delivered by the engine. Of three-quarters of a ton capacity, the hopper is set well below the pilot to afford his protection in the event of a crash. The low-wing layout is considered to facilitate loading, as an operator can jump on to the wing and guide the loading funnels into the trunk. To resist the action of chemicals and abrasion the interior of the hopper is faced with Fibreglass. Operation of the hopper-discharge doors is by two hydraulic jacks, controlled by a lever; when fully open the hopper doors allow 8in lumps of superphosphate to fall free and in emergency the entire phosphate load can be dumped in under five seconds. Built into the centre-section are two spray tanks having a total capacity of 143 gal. Provision is made for under-wing pressure-filling of the tanks and generously proportioned access panels make for easy inspection and removal.

A.O.P.9. With its Blackburn Bombardier 203 direct-injection engine, rugged construction, roominess and adaptability, this air observation post—the standard machine of its type in the Army—is popular with those who fly and maintain it. This success is partly attributable to its having been designed from the outset for its specified duties and not having been developed from an existing civil type. Its characteristics allow it to be used for casualty evacuation, light liaison, supply- and mail-dropping, cable-laying, photography and light freighting, in addition to serving as an observation post. The normal A.O.P. crew is a pilot and an observer, the latter at the rear of the cabin, facing forward or aft as required. The pilot has armour-plate protection. The picture below shows an A.O.P.9 of the Indian Army.

Aiglet Trainer. A firm favourite in the air forces and civilian flying schools of many nations, this Aiglet development was designed as a low-cost primary aerobatic trainer. Its makers claim—and its public demonstrations have assuredly confirmed—that its high-wing configuration in no way impairs its performance in its specified category. Instructor and pupil are seated side by side and a bench-type rear seat may be fitted for the use of a third person should the machine be required for touring. In this case the "aerobatic" seats are replaced by standard Auster seats.



Powerplant ... Two Rolls-Royce Dart Mk 512
Span 82ft 6in
Length ... ... 60ft 6in (Mk 1)
Gross weight ... ... 28,500 lb
Mean cruising speed 294 m.p.h.

Above and left, Accountant

AVIATION TRADERS (ENGINEERING), LTD.

15 Great Cumberland Place, London, W.1. Telephone: Ambassador 2091

Accountant. In the planning of this turboprop "DC-3 replacement" particular consideration was given to dependability and versatility; a rugged structure of long life; ability to load freight readily into some 1,300 cu ft of cabin space; low purchase price and running costs; and ability to operate from short, poorly surfaced strips. Construction of the first machine is well advanced and the first flight is expected before the end of this year. The Accountant is offered in Mk 1 or Mk 2 form. The Mk 1 is normally supplied in the bare condition to enable operators to equip the aircraft to their specific requirements; the Mk 2 can be supplied with the hinging nose or the forward freight-loading door as required. This second version is 10ft longer than the Mk 1, having a cabin volume of 1,695 cu ft compared with 1,275 cu ft. A design policy of "fail-safe" on all components was adopted, the aim being that, should fatigue troubles start, they would remain localized and be readily found at normal inspections, and repaired in the usual manner. The following are some possible versions: (1) Executive aircraft, for ranges up to 2,000 nautical miles, seating up to 18 passengers in luxury seats and with sleeping accommodation for 6 to 9 with bar facilities if required. (2) High-density 42-passenger version (Mk 2) with built-in airstairs. (3) Mixed freight and passenger version, provided with a movable bulkhead. (4) All freight aircraft, using the full cabin capacity of 1,695 cu ft and nose cargo-doors.

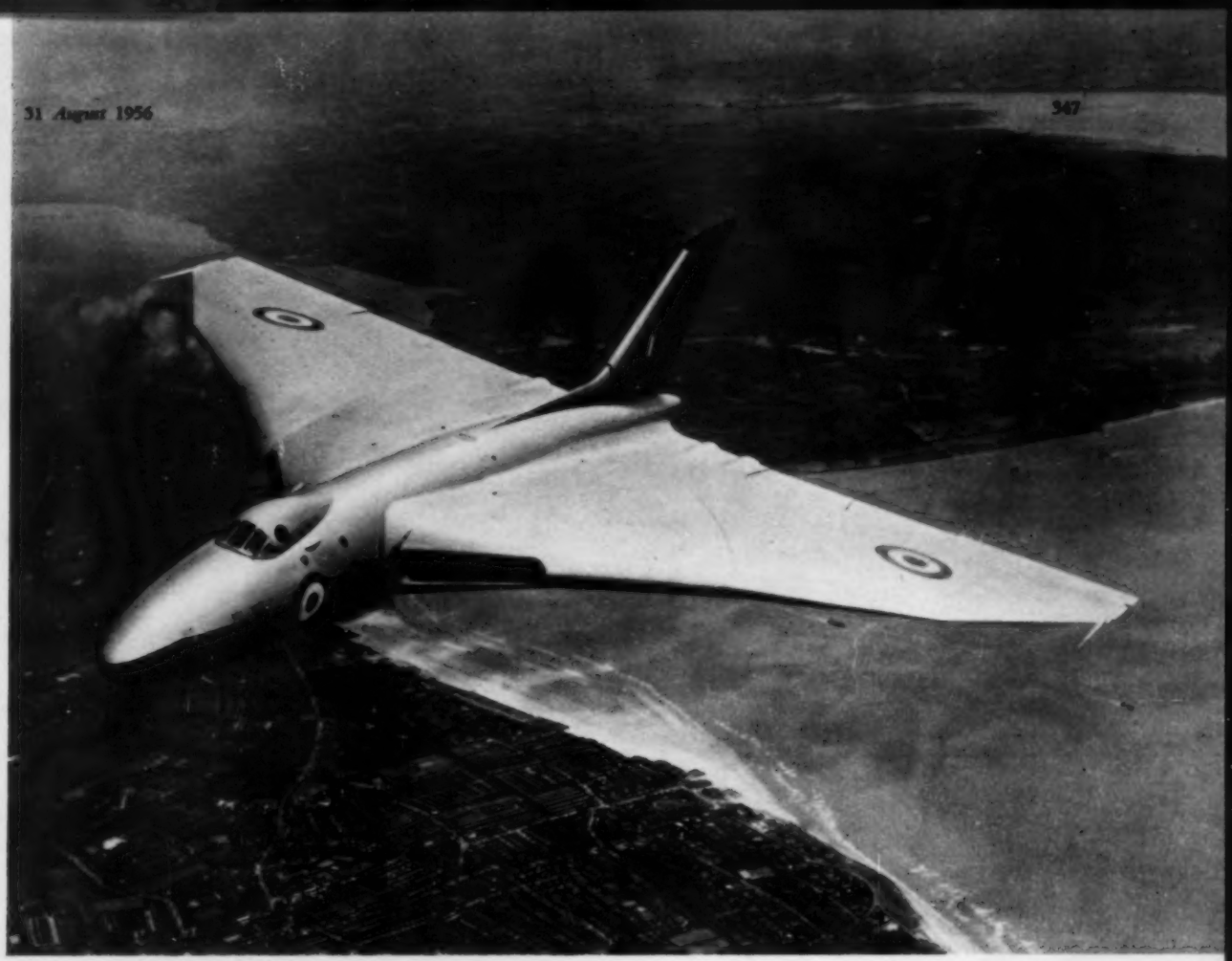
Powerplant ... Four Bristol Olympus
Span ... ... 99 ft
Length 97ft 1in

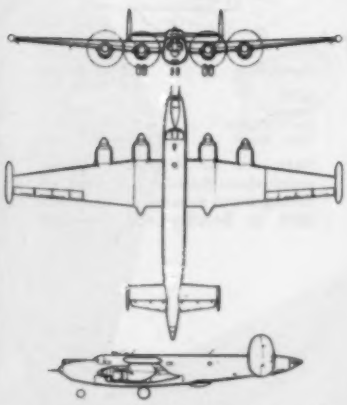
Above and upper right, Vulcan B.1

A. V. ROE & CO., LTD.

Greengate, Middleton, Manchester. Telephone: Failsworth 2020

Vulcan. The world's first delta-wing bomber, the Vulcan B.1 is expected to enter Royal Air Force service later this year. Prototypes have distinguished themselves at previous S.B.A.C. displays by their extraordinary handling qualities (last year a Vulcan executed repeated upward rolls at about 30 deg to the horizontal) and by their imposing appearance.





Powerplant ...	Four Rolls-Royce Griffon
Span	120ft 6½in
Length	87ft 4in

Above and left, Shackleton M.R.3

Since the last Display a notable modification has been made to the wing. This takes the form of a revised outer leading edge and has the effect of reducing the thickness/chord ratio and of improving both high- and low-speed performance and handling. The makers claim that the modification will "make the fullest operational use of the more powerful engines which will shortly start to become available." The power units—four Bristol Olympus two-spool turbojets—are disposed in the innermost sections of the wing. Beneath the nose is a very large dielectric fairing over what is considered to be a very advanced radar bomb-sight. An optical sighting station is retained under the nose. In March this year the Secretary of State for Air said that the performance of later marks represented a considerable development potential. Noteworthy design features—apart from the delta wing, with its relatively low thickness/chord ratio yet high internal volume—are the absence of horizontal tail surfaces; the large-area, powered ailerons and elevators on the trailing edges; the absence of flaps; and the air brakes, in the form of rectangular panels, disposed above and below the wings. An additional braking effect is conferred by the rear main-undercarriage doors and by the finely engineered Dowty eight-wheel bogie assemblies. All sixteen main wheels have Dunlop Maxaret braking control. A braking parachute is housed asymmetrically in the fuselage tail cone. It may be mentioned in passing that the name Avro has been connected with the design of a supersonic bomber, referred to in our "Military Aircraft" number of June 8.

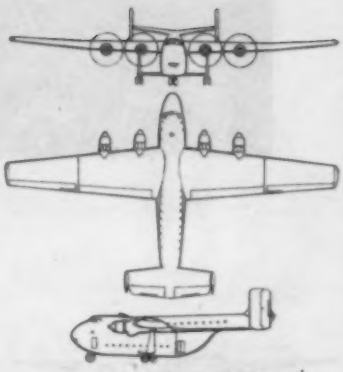
Shackleton. The Shackleton M.R.3—the third and latest mark of Avro's four-engined land-based, maritime-reconnaissance aircraft—is soon to be delivered to the Royal Air Force and South African Air Force. A logical development of the original Shackleton of 1949, it differs from the familiar M.R.2 in having a nosewheel undercarriage and increased fuel capacity, by virtue of auxiliary wing-tip tanks. A clear-view canopy is another innovation and a number of changes have been made in internal equipment. In the nose are two 20 mm British-Hispano guns, laid from a sighting station above the bomb-aimer; there is no dorsal turret, as fitted to Shackletons. The crew of ten comprises a captain, co-pilot, two navigators, an engineer, and five signallers. Crew-members may rest in a soundproofed wardroom and there is a galley to sustain them on the very long flights for which the Shackleton is intended. The Rolls-Royce Griffon engines drive de Havilland six-blade, contra-rotating, constant-speed, fully feathering airscrews. Whereas earlier Shackletons carried the search radar in the nose, the M.R.3 has a retractable installation aft of the vast weapons bay. Provision is made for a very heavy and varied load of bombs, depth charges, sonobuoys or other anti-submarine or anti-surface-vessel stores. Alternatively, an air/sea-rescue lifeboat can be carried. Handling should benefit from the incorporation of new pattern ailerons.

BLACKBURN AND GENERAL AIRCRAFT, LTD.

Brough, E. Yorks. Telephone: Brough 121

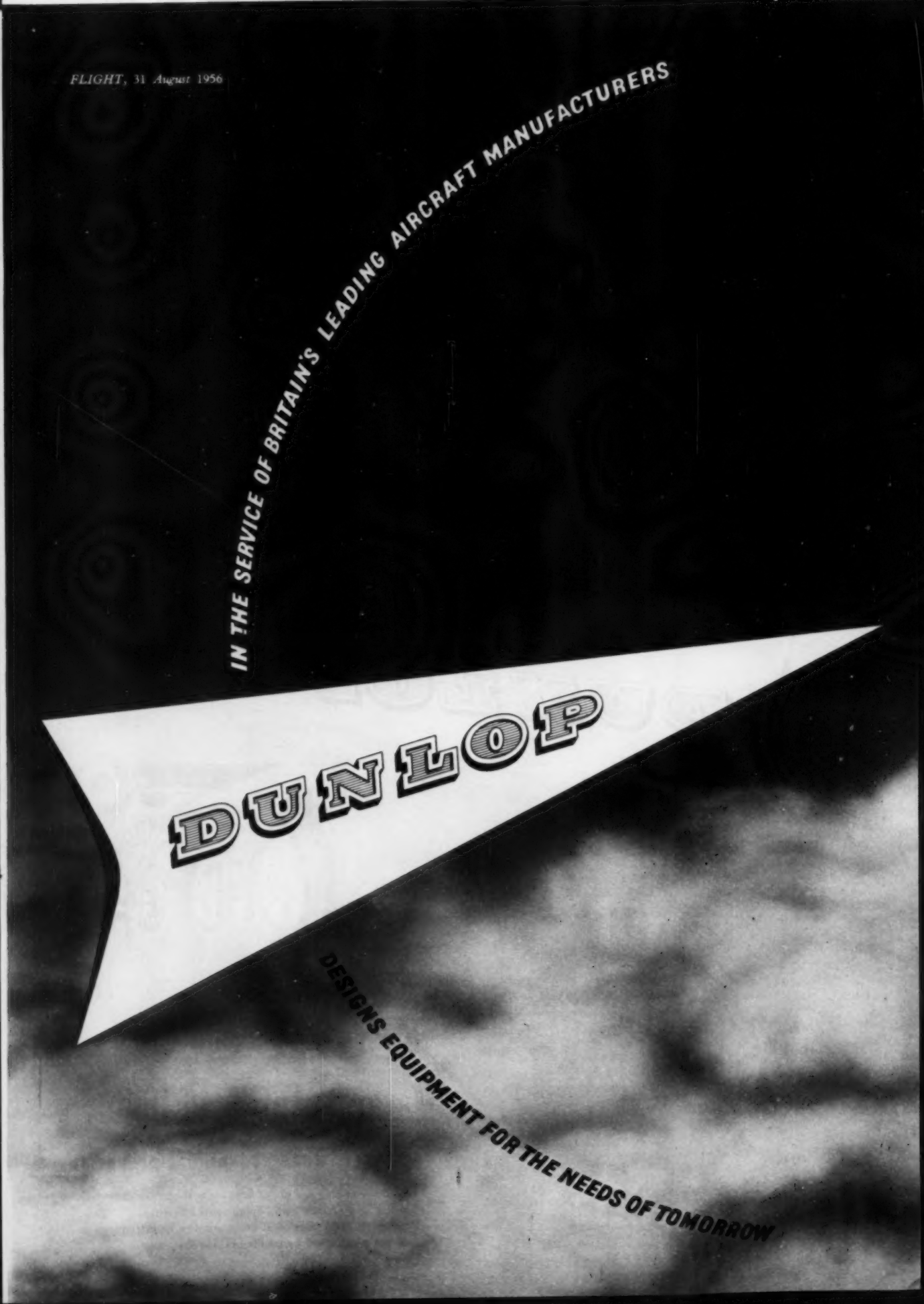
Beverley. Recent months have seen the Beverley C.1 heavy-duty military transport enter service with Royal Air Force Transport Command. Intended for the carriage of military cargo and troops and for the parachuting of troops and heavy equipment, it is designed for world-wide operations and can be used in forward areas from very short unpaved strips. Its characteristics are already well known to Farnborough-goers, so it is appropriate here to present these extracts from the report of a *Flight* representative who a few weeks ago flew in a Beverley to Germany. He wrote: "Within the Beverley's capacious hold was 29,600 lb of freight, nearly all of it in packing-cases, the heaviest items being three Avons and two car engines. In her upper compartment were nine passengers, including the writer: the Air Ministry was making it possible for us to see the Beverley operating this daily out-and-return freight service, five days a week, which forms part of its trials. The aft compartment, where we were well looked after by the air quartermasters, can seat 36 with good visibility and ventilation, and provision for a public address system. Two upward-opening trap-doors at the rear provide a ground entrance and exit (*via* steps about 17ft high) or an air exit for paratroops. Two hatches at the forward end lead down to the cargo hold (which for troop-carrying can seat 58), and progress through it to the flight deck was by a series of precarious footholds on packing-cases, rather resembling Alpine climbing and carried out (on this flight) at much the same altitude. The hold itself, 10ft wide, 10ft deep and 40ft long, epitomizes the Beverley's main advantage over the Hastings. Not only can it take three times as much; it can accommodate extremely bulky loads and the electrically operated rear doors enable cargo to be loaded and unloaded in about two-thirds of the time . . ." Going on to discuss the background of the Beverley our representative wrote that there had been a "joint requirement" for an aircraft which could fly, say, 250 miles with 300 troops and land in a small area or could fly-in a body of troops plus an armoured vehicle. Such rôles are, in fact, being investigated; but already, he reported, a Beverley had landed with 92 soldiers (most of whom had never flown before), disembarked them and taken off again all in the space of 4½ minutes. In April another *Flight* representative participated in heavy-dropping tests and reported that a 20,000 lb load had been dropped by means of six parachutes. "Tests working up to the required cluster-of-eight were continuing," he said, using the "imperturbable" Beverley.

Universal. This aircraft is the civilian counterpart of the Beverley. The differences are minor, although the Universal contains many features suggested as desirable by the airlines with whom the aircraft has been discussed, and many also which the Air Registration Board consider appropriate. The aircraft is essentially a short-hauler. With a capacity payload of about 50,000 lb it shows an operating cost which can be approached by few, if any, aircraft —8d per long-ton nautical mile. The price is £425,000, a very low figure (£3 per lb) for an aircraft of 143,000 lb gross weight. The size of the hold allows great flexibility of carrying-capacity, and loads would rarely have to be refused on account of their size. This was proved in the Universal's first real commercial operation last year, when the aircraft lifted 129 tons of bulky oil equipment between Umm Said, the Arabian oil port, and Fahud, 365 miles away. Being a relatively short-range machine (its operating costs are attractive for stages up to 1,200 miles or so) the Universal had obviously to be designed to operate from short, unpaved airstrips. With a take-off field length of 1,260 yd, and a full-load landing run of only 240 yd, it meets the small-strip requirement; and with a tyre pressure of 50 lb/sq in, and an equivalent single-wheel load comparable with that of a DC-3, the Universal's airstrip demands are very modest.



Powerplant ...	**Four Bristol Centaurus 873**
Span	162ft
Length	99ft 5in
Gross weight	143,000 lb
Max. speed ...	238 m.p.h. at 5,700ft

Data are for Universal; photograph shows Beverley C.1; general-arrangement drawing is applicable both to Beverley and Universal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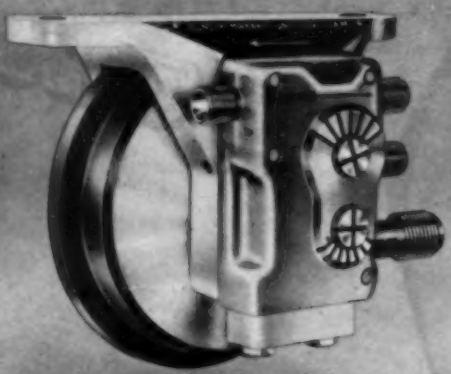

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These units permit full use of braking without skidding ensuring greater safety and operational efficiency. Dunlop 'Maxaret' Anti-skid units can now be introduced into pneumatic and hydraulic braking systems.

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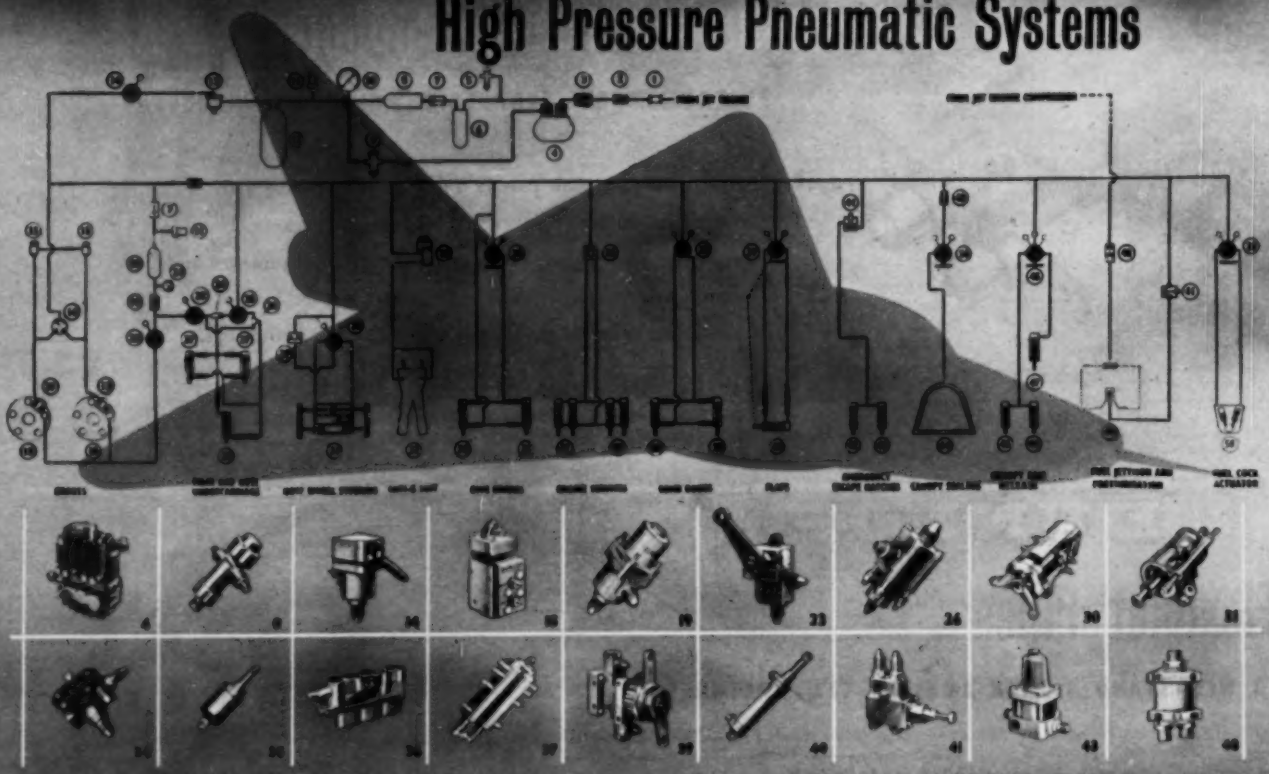

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Anti-'G' Suits and Valves

Dunlop Anti-'G' suits raise the wearers' "blackout" and "grey out" thresholds by 1½ g or more by applying pressure to the abdomen and legs to prevent the blood pooling in these areas. The suits can be used in conjunction with the Dunlop Anti-'G' valve (left). This valve automatically adjusts the pressure in the suit to protect the pilot from the effects of 3 to 8 g. It is particularly effective for closed circuit (ground charged air supply) systems and is leak-proof from 2000 p.s.i. Efficient operation is ensured from 2000 to 150 p.s.i. inlet pressure.

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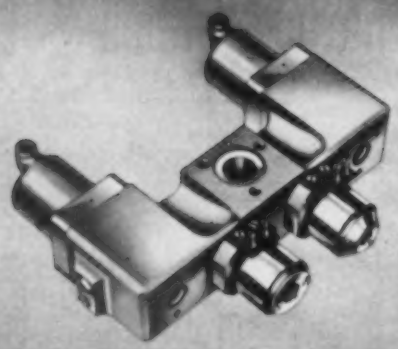
FOR ARMAMENT, PROPULSION, GUIDANCE, RECOVERY



Dunlop now play their part in a new and expanding field of aeronautical activity—guided missiles and rockets. They supply actuating equipment for the propulsion, guidance and armament of guided missiles of all types as well as providing components for recovery after test launchings.

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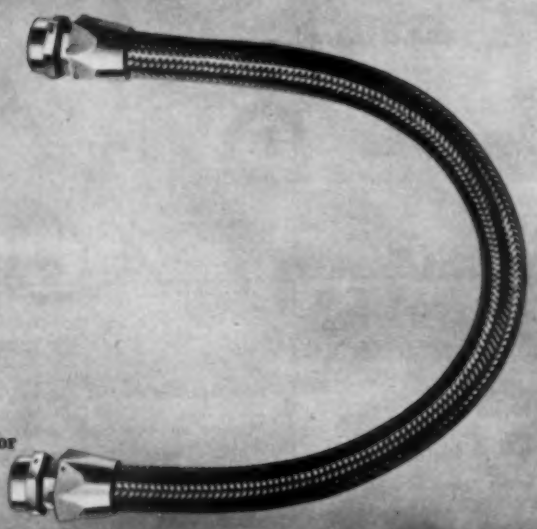
TO WITHSTAND HIGHER AMBIENT TEMPERATURES

In addition to a wide range of piping made from both rubber and silicone compounds, including those for low, medium and high pressures up to 6000 p.s.i., Dunlop supply a new all-metal flexible pipe which affords adequate protection for pressure systems subject to high temperature operation.



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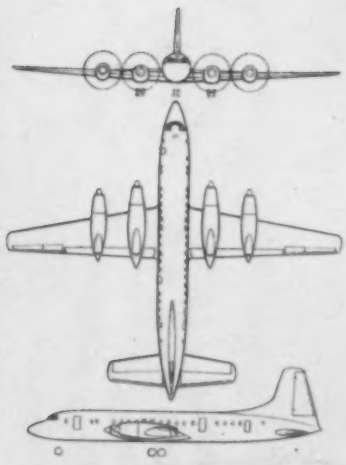
BRISTOL AIRCRAFT, LTD.

Filton House, Filton, Bristol. Telephone: Filton 3831



Powerplant	Four Bristol Proteus 755
Span	142ft 3½in
Length	124ft 3in
Gross weight... ...	175,000 lb
Cruising speed ...	400 m.p.h.

Data are for Britannia 310; photograph shows Mk 102; drawing is of Britannia 310

Britannia. Next month the first production models of Bristol's great turboprop airliner, the Britannia, are scheduled to inaugurate passenger services with the British Overseas Airways Corporation. Fifteen of the first version, the Mk 102, are being built, and the several variants of the Britannia now being offered are based upon the enlarged and more powerful 300 series. A description of these versions, which cater for the remarkably wide range-spectrum of 200 to 5,000 miles, follows, but it is appropriate first to consider the philosophy underlying Bristol's conception of the big-capacity turboprop airliner. The idea was to combine the great efficiency of the large turboprop engine with a high-capacity airframe of low structure weight, resulting in an aircraft which could carry greatly increased payloads over very much longer ranges at very much higher cruising speed—and to do this at an operating cost that would achieve new standards in revenue-earning ability. Emphasis is given to this last point by Bristol's estimate that the Britannia 310, and its medium-range derivative, the 320, are capable of breaking-even over sectors as short as 200 miles with a 25 per cent load factor. The attraction of this level of economy on the world's route networks is undoubtedly high, and with it goes a guaranteed cruising speed of 400 m.p.h. A measure of the structural efficiency achieved is the fact that structure weight is barely one quarter of gross weight, despite the low nominal stress level and the heavy fatigue-resistant properties of the design. Production of the Britannia is carried out in the large Bristol factory at Filton, and also at Belfast by Short Brothers and Harland, Ltd., under sub-contract to Bristol. Much of the aircraft, indeed, is sub-contracted—notably to Blackburns as well as to Shorts—to permit a rapid build-up of output. The power-plant comprises four Bristol Proteus 755 turboprops of 4,120 e.h.p. each (B.O.A.C.'s 102s have Proteus 705s of 3,900 e.h.p.) driving de Havilland four-blade 16-ft hollow-steel blade airscrews. The Bristol Orion turboprop, which develops some 75 per cent more cruising power, is offered also as from 1960 (delivery date now being quoted for Britannia 310 and 320 is February 1958). Flying controls are not power operated; the basic principle of operation takes the form of aerodynamic servo tabs operated directly from the cockpit. The cabin-air system is supplied by air tapped from the centrifugal high-pressure impeller of each engine, its temperature being reduced by ram-air heat exchangers, with a cold-air unit for further cooling. Electrical power is supplied by four engine-driven 50 kVa alternators, with six 24 volt 25 amp-hr batteries. Hydraulics are served by four electric pumps with a pressure of 3,500 lb to 4,000 lb/sq in to operate undercarriage retraction, control surface locking and nosewheel steering and wheel brakes. Total fuel capacity, all within the wing box-spar, is 8,486 Imp. gal. The system is suitable for kerosine or JP-4, and pressure refuelling is effected at 150 gal/min. Two systems are provided for ice protection: hot air fed from exhaust heat exchangers for engine cowlings and wings,

Powerplant	...	Alvis Leonides Mk 73
Rotor diameter	...	48ft 6.7in
Fuselage length	...	42ft
Gross weight	...	5,400 lb
Max. Speed ...	...	127 m.p.h.

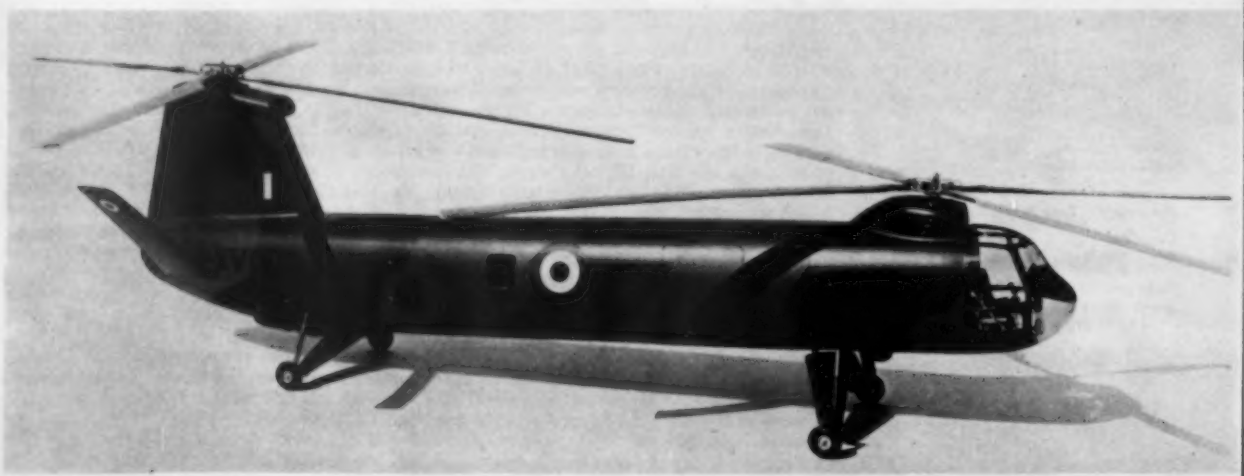
Above and left, Type 171 Sycamore

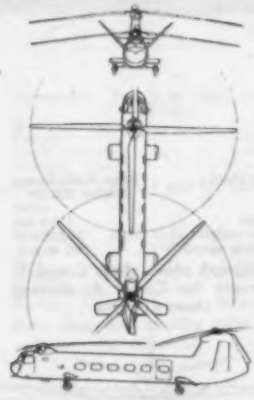
and electric mats for the empennage. Airscrew blades and spinners are heated by internal electric elements.

Provision is made in the cockpit for five crew members. A flight-director system is fitted as standard. The "systems" control panels are worthy of special note: the fuel panel, for example, is virtually a diagrammatic picture of the fuel system. Comprehensive radio and radar is fitted, including storm-warning equipment.

The cabin of the 310 and 320 aircraft is 99ft long and 12ft wide. The entire length is unobstructed, with a headroom of 6ft 8in. Seating accommodation for up to as many as 133 passengers is possible, but great flexibility is provided by slotted rails set at the international track of 31.7in. Luxury accommodation, for example, would provide for 64 passengers including 17 single berths and 15 double berths.

Principal variants are: *Britannia 102:* Initial production aircraft of which 15 are on order for B.O.A.C. (six delivered). *Britannia 300:* A lengthened version of the 102 (10ft 3in increase in length) of which two—302s—have been ordered by B.O.A.C. The prototype made its first flight on July 31. An additional five for B.O.A.C. are to be provided with 310 wing tankage to give increased range, and are designated 305. *Britannia 310:* Long-range version of the 300. Eleven 312s are on order for B.O.A.C., three 313s for El Al, and five 314s for C.P.A.L. *Britannia 320:* Medium-range version of the 310 (no physical difference between the two aircraft). *Britannia 250:* Similar to the 310. Three of these aircraft have been ordered by the M.o.S. as special mixed cargo/passenger transports, and a further ten by R.A.F. Transport Command.



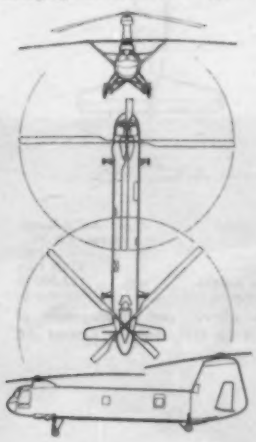


Powerplant ...	Two Alvis Leonides
Rotor diameter ...	48ft 6.7in
Fuselage length ...	... 55ft 2in
Gross weight ...	... 10,600 lb
Cruising speed ...	85 m.p.h.

Above, Type 173

Powerplant ...	Two Alvis Leonides Major or Napier Gazelle
Rotor diameter ...	... 48ft 6in
Fuselage length ...	... 50ft 3in
Gross weight (Gazelles)	18,000 lb
Cruising speed ...	138 m.p.h.

Data above, drawing below and photograph on left are for Type 192



Type 171 Sycamore. When it was announced this month that the Sycamore helicopter had been selected for service with the German Defence Forces, it was claimed that over a hundred of these 4/5-seat machines had been built and delivered and that aircraft of the type had logged some 20,000 flying hours in a dozen countries. The German contract was stated to be worth several million pounds. Numerous variants of the Sycamore have been developed to meet specific needs, but the basic machine has all the fixed fittings necessary to convert it to any of the four roles for which it is most commonly used. For search and rescue operations a hydraulically driven winch is attached to the starboard side of the fuselage. A crewman is lowered by winch to pick up a casualty and there are hand-grips to make re-boarding the helicopter easier. For ambulance duties Perspex blisters are fitted to enable two stretchers to be carried on special attachments within the cabin. Lashing-down points for cargo are standard fittings, so that the only modification needed for aerial crane duties is the attachment of a beam with a quick-release hook to the strong-points in the fuselage. For passenger transport a comfortable bench-type seat for three is installed along the rear cabin bulkhead and a single seat beside the pilot. Twenty cubic feet of stowage space are available in the luggage bay in all versions.

Type 173. A twin-engined tandem-rotor helicopter, the Type 173 is the precursor of faster and larger commercial and military types now under development. Two prototypes are in existence and one has been handed over to British European Airways for extensive handling trials. Three additional prototypes are being built and the first of these will be powered by Alvis Leonides Major engines instead of the single-row units installed in the machines now flying. The power installations, transmission systems and rotors of the Type 173 are essentially the same as those of the Sycamore. The individual gear-boxes are connected by a synchronizing shaft running along the roof of the fuselage and by this means the rotors are kept in phase and to afford single-engine safety. Both engines are isolated in steel cowlings, which form fireproof bulkheads.

Type 192. This development of the Type 173 was designed to meet a wide variety of Service requirements, and production-type 192s will be delivered to the Royal Air Force. The first production version will be powered by two vertical Alvis Leonides Majors driving inter-connected, four-blade rotors. This type of 192 will weigh 17,200 lb. Particular interest attaches to the landing gear, which consists of four distinct legs, those at the rear being very short and resulting in the 192 adopting a nose-up attitude on the ground. There are no wings, but a very large and thick fin is fitted, together with a fixed tailplane with acute dihedral. In the ambulance role a possible load will be 12 stretcher cases, three "sitting wounded" and an attendant; it will be able to pick up at least ten persons when operating on search/rescue duties and as a freight transport will carry a distributed load of 6,000 lb. On long-range operations 18 fully armed troops will be accommodated; over short ranges the 192 will be able to carry no fewer than 25 persons at an average weight of 200 lb each. In all roles provision will be made for a crew of three. The foregoing relates to the original piston-engined 192, but the basic design has been planned for turbine power and the final standard powerplant will comprise two Napier Gazelle free-turbine engines which will provide approximately double the power for less weight and allow an increase in gross weight to 18,000 lb.

THE DE HAVILLAND AIRCRAFT CO., LTD.

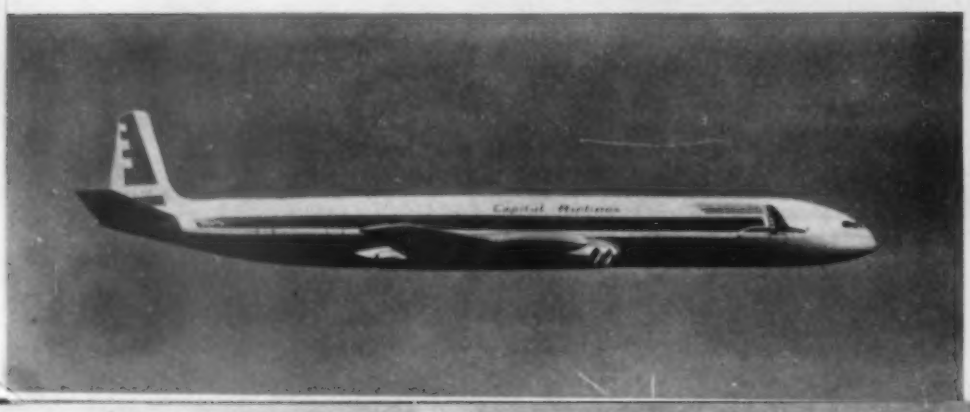
Hatfield Aerodrome, Herts. Telephones: Hatfield 2345

Comet 4 and 4A. The Comet 4 and its specialized medium-range derivative the Comet 4A are now factors of significance in the re-equipment plans of several operators. In July last, world attention was suddenly and sharply focussed on these de Havilland jet airliners when one of the leading United States domestic operators—Capital Airlines—placed an order for ten Series 4As and four Series 4s. Capital's historic decision meant that the challenge of the jet airliner in a sphere hitherto the preserve of the turboprop—i.e., over ranges of 500 to 1,500 miles—had become a very serious one indeed. D.H. realized that the travelling public, having tasted DC-8 and 707 jet travel on long-haul routes, would partake of it also on medium stages, and this philosophy was shared by Douglas and Convair with, respectively, the DC-9 and Golden Arrow projects. D.H. were quick to exploit the great advantage of having had the Comet flying and under development for seven years, and the scope for the aircraft is now seen perhaps more clearly than ever before.

Briefly, the Comet 4 is intended for airlines with route sectors lying mainly in the 2,000 to 3,000 mile bracket, where cruising altitudes of 30,000ft and above can be used without the penalty in block time which would be incurred by operating to this technique over short ranges. The 4A, on the other hand, is the choice for those airlines whose networks lie in the 500 to 1,500 mile band (e.g. U.S. operators). The true cruising airspeed of this version has been raised from 500 to 530 m.p.h., and the aircraft made structurally adequate for operation at lower altitudes. The actual height at which the Comet 4A's indicated airspeed limit intersects the Mach compressibility limit is 23,500ft, although there is considerable flexibility above and below this altitude. Maximum payload has been increased to offset the fuel costs (which, despite the higher speed, are higher at these altitudes) by an increase in fuselage length and a raising of zero fuel weight by some 4,000 lb. Comparative tourist capacity payloads for the Comet 4 and Comet 4A are, respectively 19,300 lb and 22,690 lb. The Comet 4A can, of course, be

Powerplant ...	Four Rolls-Royce Avon RA.29
Span	115ft
Length	111ft 6in
Gross weight... ...	152,500 lb
Cruising speed ...	505 m.p.h.

Photograph above shows Comet 3; data are for Comet 4; drawing shows Comet 4.



Powerplant ...	Four Rolls-Royce Avon RA.29
Span	108ft
Length	114ft 10in
Gross weight... ...	152,500 lb
Cruising speed ...	530 m.p.h.

Data above, and photograph of model on left, are for Comet 4A

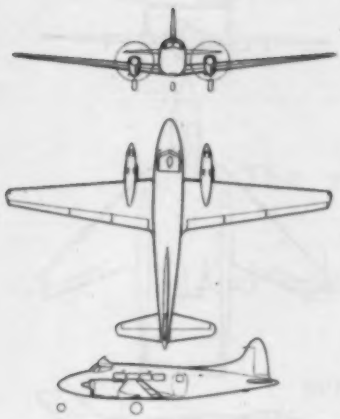
operated according to the Comet 4's high-altitude procedure, being able to achieve thereby full-payload range of up to about 2,700 miles.

Delivery of the Comet 4 is offered for late 1958, and for the Comet 4A in the early part of 1959. Direct operating cost, although not as low as can be offered by projected turboprop airliners, nevertheless is highly competitive: a break-even load factor on American routes of about 50 per cent on 600-mile stages is offered by the Comet 4A, while actual seat-mile cost over a 1,500-mile stage (tourist) is of the order of 1.5d.

The basic principle of the structural formula applied to the new Comets is the progressive reduction of stress levels as cut-outs, seams and other stress-raisers are approached. Many thousands of individual tests have been undertaken to explore thoroughly the fatigue-resistant properties of the whole airframe; window specimens, for example, have lasted the equivalent of about 800,000 hr of flying. The powerplant of both Comet 4 and Comet 4A comprises four Rolls-Royce Avon RA.29s of 10,500 lb thrust each. Noise-reduction nozzles and thrust-reversers can be fitted. The air supply for the cabin air system is tapped from the compressors of each engine, one of which is sufficient to maintain pressure and conditioning to the required level. Cooling of this air is by ram-air heat-exchangers and cold-air units of D.H. design. Maximum designed cabin pressure differential is 8¾ lb/sq in, and pressure control is fully automatic; it is necessary only to pre-select the altitude at which it is required to start pressurizing.

Main electrical supply is from four alternators; six 24-volt, 25 amp-hr batteries are installed. The hydraulic system, normal operation of which is at 2,500 lb/sq in, serves flying controls, undercarriage retraction, flaps, air brakes, wheel brakes and nose-wheel steering. Total fuel capacity is 8,950 Imp. gal. for the Comet 4, and 8,730 Imp. gal. for the 4A. Refuelling is accomplished *via* under-wing connections at 200 Imp. gal/min. Protection of airframe and engine air intakes against ice formation is accomplished by means of hot air tapped from the engine compressors. The flying control system is operated hydraulically, with feel proportional to air speed provided in the elevator circuit. The flying control system is duplicated mechanically and triplicated hydraulically.

Payload accommodation for the Comet 4 varies from 58 seats first-class to 76 tourist, and for the 4A from 70 first-class to 92 tourist.



Powerplant	Two D.H. Gipsy Queen 70 Mk 2
Span	57ft 0in
Length	39ft 3in
Gross weight	8,800 lb
Cruising speed	179 m.p.h.

Data and drawing are for Dove 5

Dove. This will be the eleventh successive year in which the Dove has appeared at the S.B.A.C. display. Here, indeed, is an indication of the popularity of this de Havilland "airliner in miniature," some 500 of which have now been built, and which continues to sell steadily. It started its life as an airline-passenger transport, in which rôle it continues to serve in about 20 countries, but its forté today (for which it is being supplied off the production line) is as an executive aeroplane. To date about 90 have been sold to private owners in the U.S.A. alone.

The formula which inspired the Dove towards the end of the war, and which has served it so well ever since, was the application of "big airliner" sophistication to an aircraft of feeder-line dimensions—retractable nose-wheel undercarriage, geared and supercharged engines with direct fuel injection, feathering and (if required) reversing propellers, full dual control, comprehensive radio and instruments, and metal construction. Although a small aircraft the Dove nevertheless affords a considerable measure of passenger comfort, and it can carry a payload of nearly a ton on the relatively short stages for which it was designed.

Like the Heron, the Dove is an "all-D.H." product, airframe, engines and airscrews being all of de Havilland design and manufacture. Many components are interchangeable between the two aircraft, which, in point of fact, come off the same assembly line at Chester. The Devon and Sea Devon are military versions.

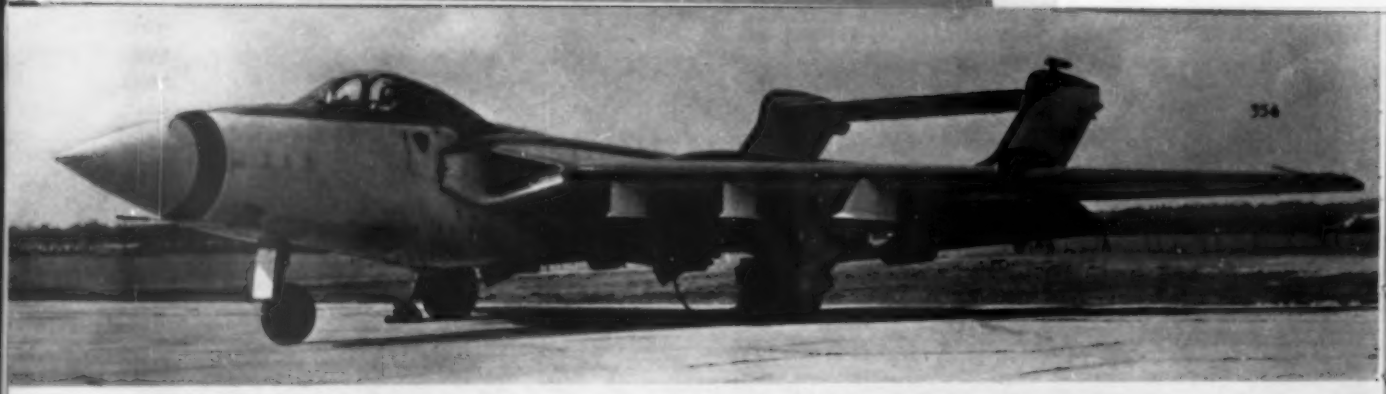
Powerplant	Four D.H. Gipsy Queen 30 Mk 2
Span	71ft 6in
Length	48ft 6in
Gross weight	13,000 lb
Cruising speed	183 m.p.h.

Data above and drawing below are for Heron 2

Heron. The design philosophy of the de Havilland Heron may be summed up very briefly: four-engined safety in an aircraft of a size (14 to 17 passengers) not normally provided with such benefits. The aircraft has two rôles. Its primary application is to high-frequency service on local multi-stop networks, serving communities off the beaten track in much the same way as a country bus. The second rôle is as an executive aircraft, and indeed about a half of current sales are in this ever-widening field. The most outstanding performance characteristic is its short field-requirement which, in addition to its sturdy and simple structure, makes it ideal for "outback" operations. It is, however, equipped to a degree which renders it equally at home in busy terminal operations.

The Heron is powered by four D.H. Gipsy Queen 30 Mark 2 direct-drive, unsupercharged piston engines of 250 b.h.p. Airscrews are D.H. two-bladers, incorporating feathering if required. There are no hydraulics in the aircraft; all airframe services such as undercarriage retraction, flaps, brakes, etc., are pneumatic. Maximum fuel tankage is 316 Imp. gal. Payload accommodation is for 14 to 17 passengers in the airliner version; the luxury executive arrangement provides for eight people.

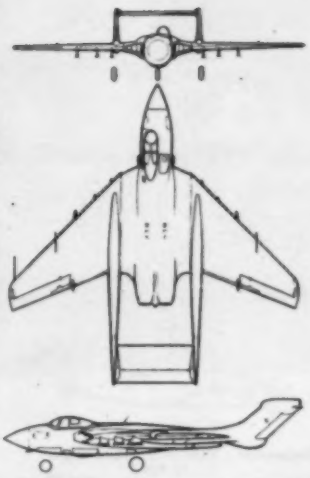
Dove Series 5.



D.H. 110. A two-seat carrier-based night and all-weather fighter of outstanding merit, the D.H. 110 is in production for the Fleet Air Arm. The design was prepared with Naval requirements in mind and it was reasoned that the traditional de Havilland twin-boom layout offered two particular advantages in that carrier stowage was facilitated (it being possible to push the nose of one machine beneath the high-set tail of the machine in front) and the installation of an arrester hook was relatively easy. Not the least remarkable feature of the machine is its power-control system, which was the subject of a detailed appraisal in Flight of July 13. On that occasion it was remarked: "Considerable development flying has been required to perfect its handling qualities over the very wide speed range required, and much of the testing programme has been aimed at providing low-speed flying characteristics at least as good as, or better than, those of other naval aircraft, as well as affording a quality of control at high speeds that would match the speed and altitude capabilities of the aircraft. To satisfy its particular function, a fighter of this type must be highly manœuvrable at speeds ranging from that of the slow carrier approach to the supersonic dive; and, above all, it must be free from vices at all speeds in the conditions likely to be encountered in all-weather work. Most Service aircraft to date have been limited to a critical Mach number by the compressibility effect encountered at the high speeds easily attained at high altitudes. The D.H. 110 was found to be free from such restrictions and so, from the outset, it was possible to concentrate on the fundamental problems which are common to all aircraft designed to operate at transonic and supersonic speeds, namely those of providing throughout this speed range, positive and accurate control and stability for gun-firing and weapon-launching."

It was remarked on the same occasion that an automatic pilot was an obvious advantage in an all-weather fighter because it relieved the human pilot of the need for concentrating on instrument flying during unaccelerated flight conditions such as climb, patrol and descent. "For this reason," the account ran, "a two-axis autopilot has been fitted. This allows the pilot to select climb, constant altitude or descent, and to perform low-rate turns in the cruising or stacking pattern. Since the ailerons of the D.H. 110 are well aft of the centre of gravity they have been adapted as autopilot elevons to give both pitch and roll control from a single control surface. Further complication of the tailplane control system is thus avoided and the danger from autopilot malfunctioning is limited. As a two-axis autopilot is used turns are unco-ordinated, but the amount of rudder employed on this type of aircraft is so small that the ensuing yaw is unnoticeable."

Armament is four 30 mm Aden guns and under-wing air-to-air guided missiles. The guns are mounted beneath the cockpit floor on a demountable pack and ready access is provided for the ammunition loader and gun-hoist winch. The operational version of the D.H. 110 now in production is known as the Mk 20 (no name has yet been chosen) and will probably incorporate a more advanced mark of the Rolls-Royce Avon than that at present installed. Among comparatively recent developments is the repositioning of the dive brake, which is now in the form of a single large surface under the forward fuselage. The large internal fuel capacity can be augmented by two external plastic tanks. Advanced A.I. radar and gun-laying equipment are, of course, provided. Having completed carrier trials, the D.H. 110 is now undergoing further development flying and work is proceeding on the production machines, which will have power-folding wings, a new-type of pointed radome, shown in the picture on this page, a long-stroke undercarriage and nosewheel steering.

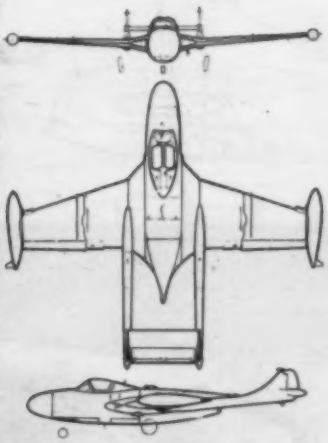


Powerplant	...Two Rolls-Royce Avon
Span ...	... ... 51ft
Length	... ... 52ft

Drawing and photograph show D.H.110 as at present flying

Powerplant	... ... D.H. Ghost
Span ...	... ... 41ft 9in
Length	... ... 35ft 3in

Drawing and photograph below show Sea Venom FAW.21



A summary of

ACHIEVEMENT

The recent technical
and operational advances
wrought by a
single company with
world-wide resources

DELTA 2

FIREFLASH

GANNET

ROTODYNE

FIREFLY TARGET

ENVELOPE TOOLING

POWER CONTROLS

INVESTMENT CASTINGS

FAIREY

THE FAIREY AVIATION COMPANY LIMITED

ENGLAND · AUSTRALIA · CANADA

FD2

The Fairey Delta 2, powered by a Rolls-Royce Avon jet engine, was the first aircraft in the world to exceed a speed of 1,000 m.p.h. in straight and level flight over a measured course under F.A.I. conditions. It achieved this distinction while establishing an Official World Speed Record of 1,132 m.p.h. in March, 1956.

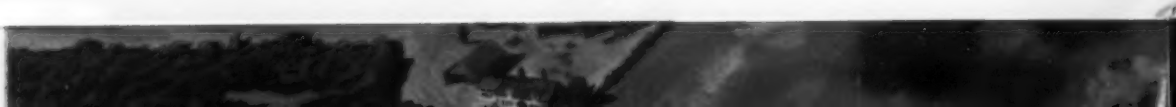
Two Fairey Delta 2's are employed on a high-speed research programme for the Ministry of Supply. The data they provide will be used for the benefit of British aviation as a whole.

FAIREY

FIREFLASH

The Fairey Fireflash was the first British air-to-air guided weapon to destroy a radio-controlled target aircraft—a Firefly drone developed by the Company as part of the weapons programme. Fireflash is in production for the Royal Air Force and is under consideration by N.A T.O. air forces.

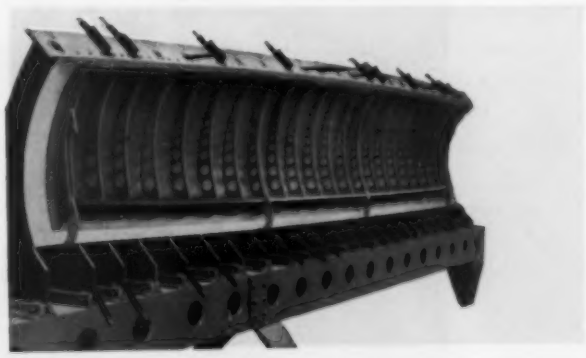
WEAPON DIVISION OF *FAIREY*



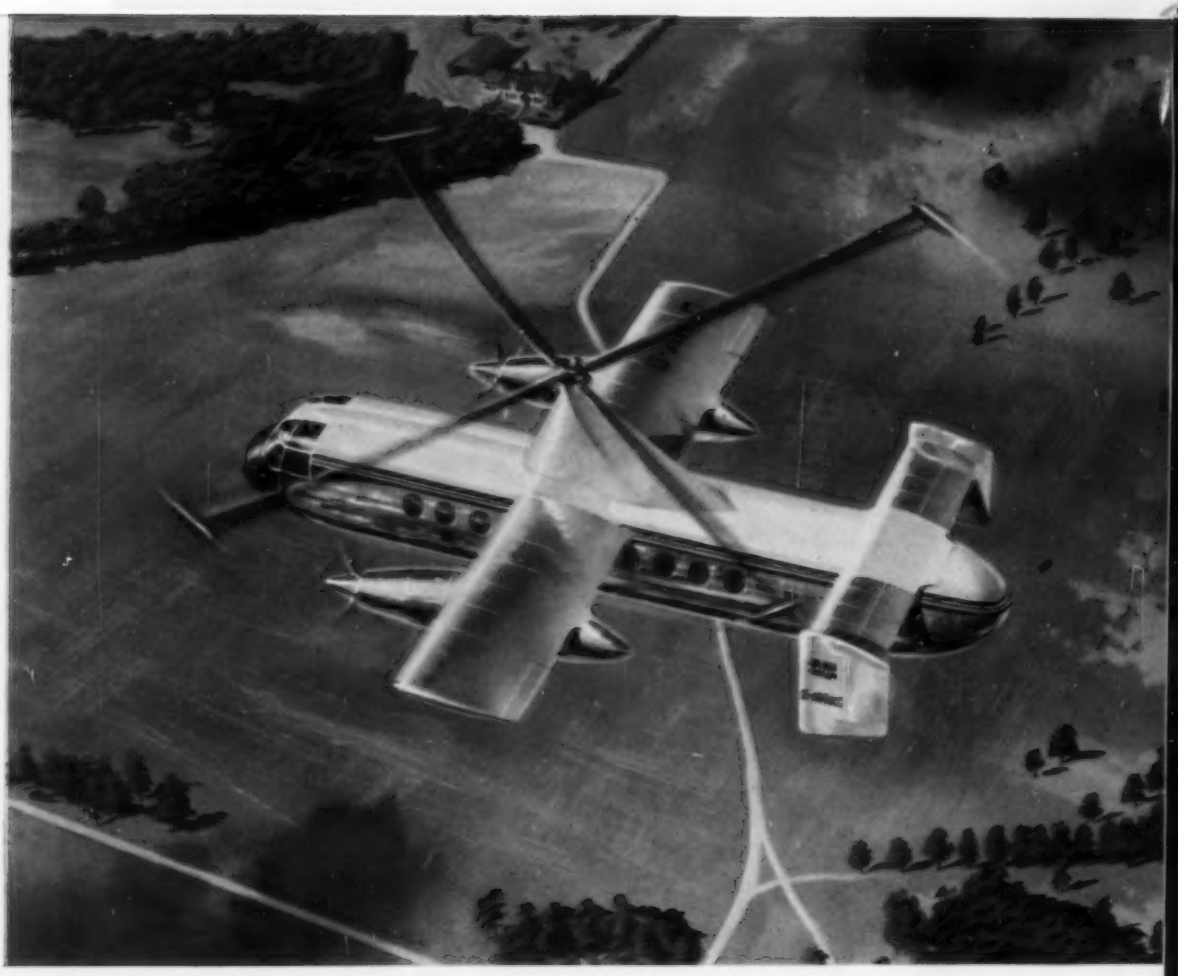
Flight,
31 August
1956

GANNET and envelope tooling

Fairey Gannets and their method of construction exemplify the independent outlook and practical originality of Fairey engineering. Fairey developed the "twin engines in single installation" layout (an Armstrong Siddeley Double Mamba) which contributes so much to the operational success of the Gannet. Fairey designed Envelope Tooling, the revolutionary system of jigging in which aircraft are constructed from the skin inwards. Among the advantages of Envelope Tooling are complete interchangeability and greatly reduced time-lag between prototype and production aircraft.



FAIREY

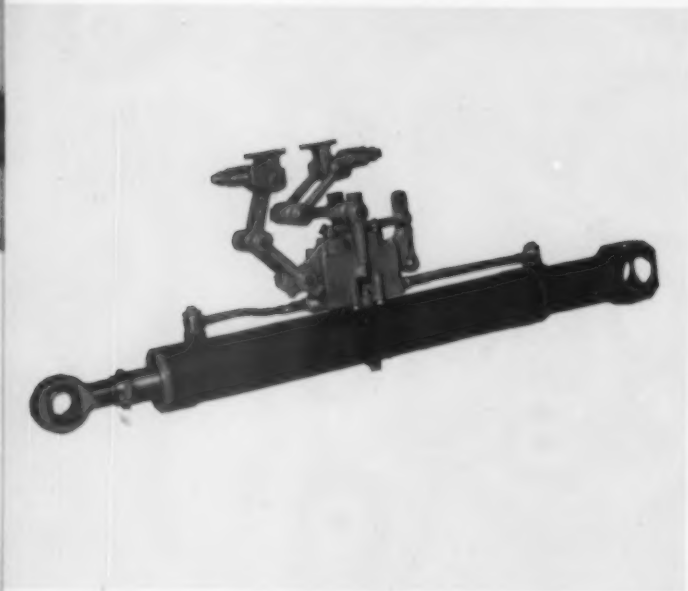


ROTODYNE

The essential features of both the helicopter and the Autogyro combine in the Fairey Rotodyne to provide economical payload (11,000 lb. or 44 passengers), twin engine reliability, outstanding safety and high forward speed (not less than 150 m.p.h. cruising). For take-off compressed air supplied by two Napier Elands is burned with fuel at the rotor tips. For forward flight the power is transferred to the propellers, the rotor auto-rotating to share the lift with the fixed wings.

FIREFLY TARGET

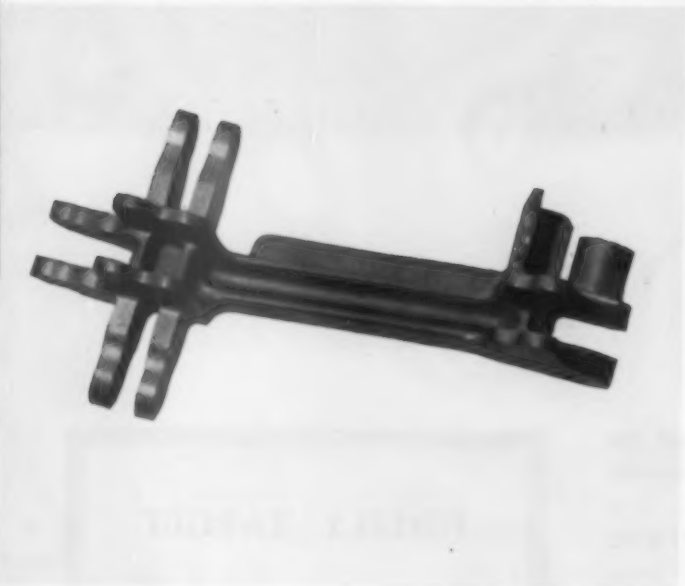
Fairey developed and produced, in conjunction with the Royal Aircraft Establishment, Farnborough, the pilotless Firefly drone. It is the only radio-controlled target aircraft used in this country for trials with guided weapons of all types.



Fairey Power Controls are in widespread use in both British and foreign high-performance aircraft such as the Hawker Hunter, Avro (Canada) CF-100, Hawker Sea Hawk, Vickers-Armstrongs Supermarine N.113, Aerfer Sagittario, and, of course, the Fairey Deltas. Here again Fairey have developed new manufacturing processes enabling the accuracy required in this highly precise assembly—sometimes in the order of one millionth of an inch — to be attained simply and economically, without prejudice to operational serviceability.

A new full-flow micron filter that stops all particles down to 4 microns (.00016 of an inch) has been produced by Fairey for use with power control units and other hydraulic components.

POWER CONTROLS



INVESTMENT STEEL CASTINGS

Fairey was the first company to be given approval by the Ministry of Supply for manufacture of aircraft structural fittings in high-strength alloy steels by investment casting. It now has several years of experience in the production of these castings in a wide variety of forms and sizes, including the main wing attachment illustrated. The process developed by Fairey is particularly appropriate to fittings of complex form requiring consistently high mechanical properties; they can be produced more easily and cheaply than by other methods with finish machining reduced to a minimum.

Fairey has subsidiaries and associates in England, Australia, Canada, Belgium, Rhodesia, India and Pakistan. In addition to delta research, guided weapons, anti-submarine aircraft, new methods of aircraft construction, helicopter design and production, radio controlled target drones, power controls and investment steel castings, its activities extend to aerial survey, design and production of plastic components, and repair and maintenance.

A constantly expanding programme of research and development ensures that the Company holds its lead in the industry in all aspects of future design.

FAIREY

The Fairey Aviation Company Limited

ENGLAND · AUSTRALIA · CANADA

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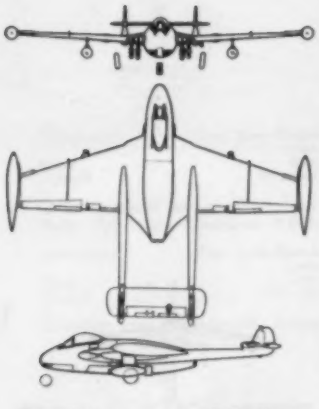
PUB/R/BM/2/56

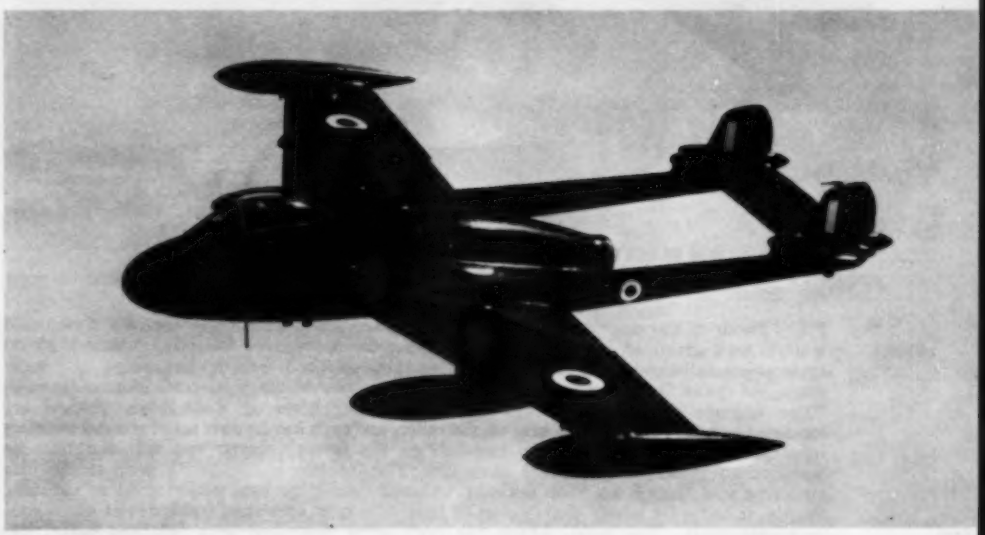
Venom N.F.3.

Vampire Trainer.



Powerplant	... ...	D.H. Ghost
Span	... ...	41ft 9in
Length	... ...	33ft

Drawing above and photograph at right show Venom F.B.4.

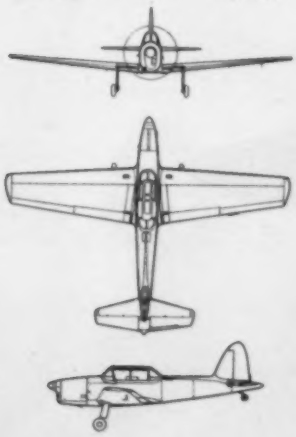


Venom Night Fighter. Venom side-by-side-seater night fighters are used not only by the R.A.F. but by the Royal Swedish Air Force also. The latest R.A.F. variant is the N.F.3, which has improved flying controls, more modern radar than its precursor the N.F.2, and a clear-vision cockpit canopy. The Ghost turbojet is of a late mark and armament is four 20 mm British-Hispano guns.

Venom Fighter/Bomber. The single-seat Venom serves as a high- or low-altitude fighter or as a fighter/bomber, and the latest R.A.F. version is the F.B.4. In common with other Venoms of recent production this has hydraulically operated ailerons, incorporating artificial feel and having provision for automatic reversion to full manual control in emergency. This control system is claimed by the makers to confer a considerable gain in combat efficiency. Further benefit is derived from redesigned fins and rudders and a tailplane of greater span. Built-in armament is four 20 mm British-Hispano guns. Venom fighter/bombers are serving in Switzerland, Burma and Iraq as well as with the R.A.F.

Below and lower right, Chipmunk.

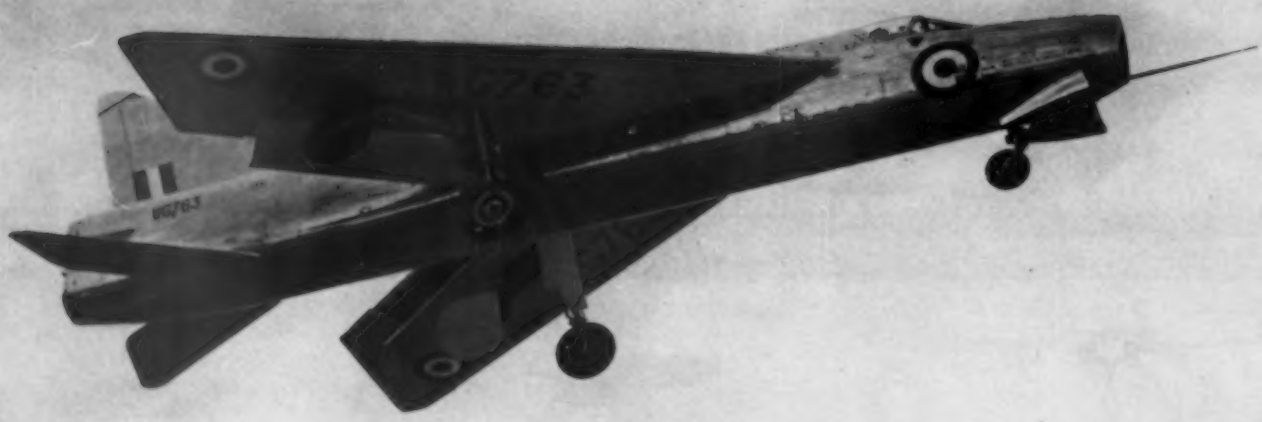
Powerplant	...	D.H. Gipsy Major
Span	... ...	34ft 4in
Length	... ...	25ft 5in
Gross weight	... ...	2,014 lb
Max. speed	... ...	138 m.p.h.



Sea Venom. Standard all-weather fighter of the Royal Navy until the introduction of the D.H.110 is the Sea Venom FAW.21, the naval counterpart of the N.F.3. It has power-folding wings, catapult gear, provision for rocket-assisted take-off and an arrester hook. Armament is four 20 mm guns. A similar machine (FAW.53) is used by the Royal Australian Navy, and a development of the Sea Venom, called the Aquilon, is built under licence in France in both single-seat and two-seat forms.

Vampire Trainer. The Vampire Trainer (R.A.F. designation Vampire T.11) is the most widely used machine of its class in the world and all R.A.F. pilots now earn their wings on the type. Usually they go solo after about 6½ hours, having received *ab initio* instruction on the Hunting Percival Provost or Jet Provost. Instructor and pupil sit side by side in a pressurized cockpit with clear-view canopy. Ejection seats are fitted, and provision is made for instruction and practice in fighter navigation, combat, bombing, gunnery and rocket firing. With two 20 mm guns and full internal fuel it is possible to carry several combinations of rockets, bombs and external tanks.

Chipmunk. This Canadian-designed trainer remains popular, and to date about 1,000 have been built in England. Construction is all-metal and the undercarriage is fixed.

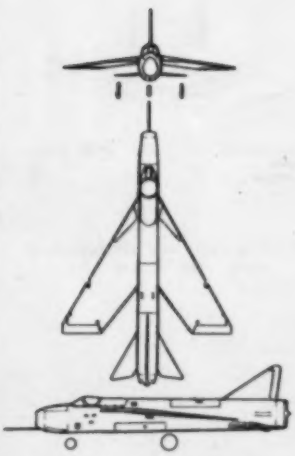


THE ENGLISH ELECTRIC CO., LTD.

Queen's House, Kingsway, London, W.C.2. Telephone: Holborn 6966

P.1. Three of the five prototypes of the P.1 supersonic intercepter are now flying and work is well advanced on 20 pre-production machines intended for development work on systems, installations and techniques. Officially released information being extremely scant, we quote from our review of the aircraft in our Military Aircraft issue of June 8: "The engines themselves [Armstrong Siddeley Sapphires or Rolls-Royce Avons] are mounted one above, and to the rear of, the other, and each has its own set of ground-running intakes. Afterburners have been installed on the first prototype and will doubtless be standard equipment on all future examples. The fuselage is basically a deep rectangular structure and though its form appears 'unaerodynamic' to eyes accustomed to subsonic shapes, it has a far better distribution of cross-sectional area than machines of more conventional form. The wing, which has been aptly described as a 'notched delta', has a leading-edge sweep of 60 deg and a thickness/chord ratio of perhaps 5 per cent. Subtle changes in profile can be discerned at various points (the inner leading edge is drooped), these having been introduced following experience with the Short S.B.5 aerodynamic test vehicle. Small 'saw-cut' slots, parallel with the incident air flow, act as wing fences. The tailplane is of the slab type, similar in plan-form to the wing.

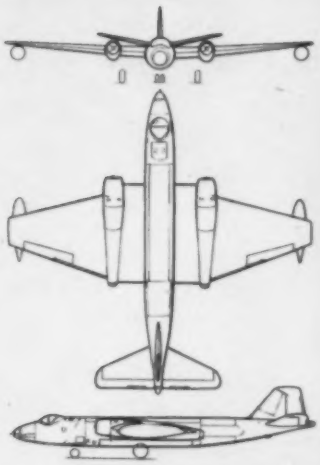
"Much of the fuel must be carried within the wing, and provision may be made for guns in addition to the guided missiles which will, of course, form the principal war load. Armament has, in any case, been officially described as 'very heavy' . . . Gun and missile 'packs' appear feasible, and the missiles themselves might be of the reported de Havilland type, using infra-red detection. An ingenious undercarriage was devised for the P.1 in conjunction with British Messier, the main leg being hinged roughly in the geometric centre of the wing and folding outward. The nose leg retracts forwards and the single wheel lies flat under the intake duct. Within a few days of its maiden flight the P.1 exceeded the speed of sound in a dive on several occasions and shortly thereafter was regularly flying at Mach numbers in excess of 1 in level flight without the use of afterburning or any other form of power-boosting device. In March this year it was disclosed that the first prototype had flown with reheat and that the two prototypes had completed some 300 flights, mostly in the supersonic regime and on many occasions with an R.A.F. pilot . . . Demonstrated manoeuvrability of the P.1 is of a very high order indeed, for the wing loading is moderate, and fly-pasts at speeds of 150 kt or less have been witnessed."



Powerplant ...	Two Armstrong Siddeley Sapphire or Rolls-Royce Avon
Span	36ft
Length	54ft

(Dimensions are approximate)

Canberra P.R.9.

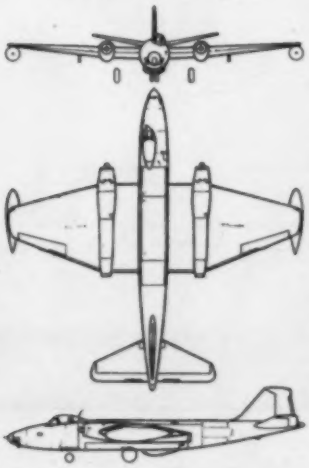


Powerplant ... Two Rolls-Royce Avon
Span 68ft
Length 66ft 8in

Drawing above and photograph at lower left show Canberra P.R.9.

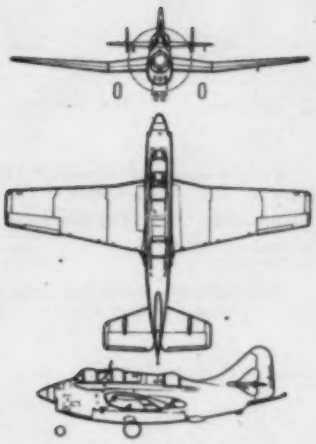
Powerplant ... Two Rolls-Royce Avon
Span 64ft
Length 65ft 6in

Drawing and photograph below show Canberra B(I).8.



Canberra T.4

Canberra. Notwithstanding the Canberra's now lengthy (and altogether exemplary) service with the Royal Air Force and with the air arms of several other nations, details of its performance and of its military capabilities are still withheld. Principal variants now current are the T.4 trainer; the B.6 light bomber (this has an Australian counterpart in the B.20); the P.R.7 photographic reconnaissance machine; the B(I).8 intruder; and the P.R.9 ultra-high-altitude photographic reconnaissance machine. The B(I).8 is the most versatile member of the family, being capable of operating as a night interdictor, high- or low-altitude bomber, target marker or reconnaissance aircraft. The forward fuselage is wholly new in design and is arranged for visual bombing with a crew of two, the navigator being seated ahead of the pilot, who is seated under a fighter-type canopy offset to port. Various weapons can be carried internally and on under-wing pylons. For ground attack and night intrusion the aircraft carries four 20 mm guns, combined with ammunition supply, in a quickly replaceable pack developed by Boulton Paul. A very large quantity of ammunition is provided for each gun, possibly of the order of 500 rounds. Pending introduction of B(I).8s into squadrons converted B.6s, known as B(I).6s, have been placed in service. These otherwise standard bombers carry a gun pack and wing bomb pylons. Production of B(I).8s is well advanced and first deliveries to squadrons are imminent.



Powerplant	...	Armstrong Siddeley Double Mamba
Span	... ...	54ft 4in
Length	... ...	43ft

Drawing and photograph show Gannet A.S.1.

THE FAIREY AVIATION CO., LTD.

Hayes, Middx. Telephons: Hayes 3800

Gannet. Though the extent and rate of Gannet production are secret, many scores of these turboprop-powered carrier-borne anti-submarine aircraft have now been delivered for service with the Fleet Air Arm and the Royal Australian Navy. In recent weeks it has been announced that a batch of 16 Gannets is to be built for the West German Government. Included will be one operational trainer version, to which versatile variant reference is later made. Total value of the order, including spares and equipment, is over £2 million.

Specialized anti-submarine versions of the Gannet are the A.S.1 and A.S.4, the latter presumed to have a more powerful version of the Armstrong Siddeley Double Mamba turboprop than its predecessor. The Double Mamba is itself the key to the design of the Gannet. It has a low noise level, needs no flame dampers and allows the Gannet to fly happily on one half-engine. This capability is claimed to confer the following advantages: (1) the factor of double safety is introduced, since the aircraft is in effect twin-engined; (2) maintenance is reduced, since for most of its flying life only one half of the engine is in use, and this brings advantages concerning the overall wear and tear in the life of the engine; (3) while sufficient power for cruising is available from one half of the engine, full power of the double engine ensures an excellent take-off and a reserve of power for emergency use (for example, on going in to attack or on a baulked approach to deck landing). Precise details of the Gannet's military load are withheld, but visitors to the S.B.A.C. Display last year may recall that on view was an impressive assortment of stores, ranging from rockets and practice bombs, through large air/sea-rescue containers to 500 lb, 1,000 lb and 2,000 lb mines. Sonobuoys were included and there were flame-, smoke- and noise-producing floats, but no specific anti-submarine weapons other than special

Gannet T.2.

WESTLAND

The Westland range · · · Left: 'Dragonfly' — Flying (left) 'Whirlwind' Hovering (right) 'Widgeon' and (foreground) new Westland 'Wessex'

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The ejection seat used by air forces of twenty-six nations

The Martin-Baker Patent Fully Automatic Light-weight Ejection Seat, Mark 4, is designed to function efficiently at all operating heights and speeds of which contemporary and projected aircraft are capable. This seat is most compact and weighs only 80 lb. when fitted with the telescopic 85 ft. per second gun. The remarkably low installed weight has been achieved by considerable design ingenuity.

The seat is fitted with the Martin-Baker Patent explosive hood jettison equipment, which enables the occupant to fire himself out of the aircraft with the operation of one control only. When fired, the hood is jettisoned by explosive jacks, followed automatically, a second later, by the ejection seat.

Martin-Baker Ejection Seats have been responsible for saving the lives of many airmen throughout the world.

MARTIN-BAKER AIRCRAFT COMPANY LIMITED

ENGLAND —— CANADA

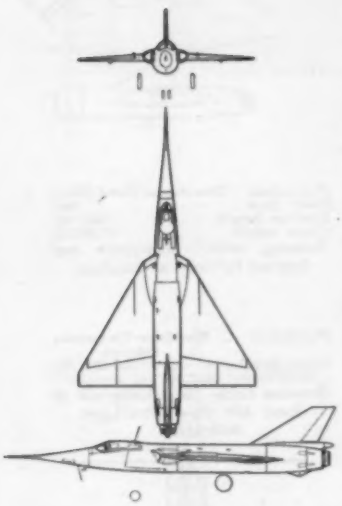
bombs. It is known, however, that the Gannet can carry the most up-to-date "A.S." weapons, including homing torpedoes.

The operational trainer version of the Gannet is designated T.2 and has been developed to provide advanced training for crews in weapon and engine handling. The pupil is seated, with the instructor, in the second cockpit, wherein all controls are duplicated. As a communications aircraft the T.2 can be flown with a radio operator and two passengers aft.

A radar early-warning version of the Gannet is under development.

F.D.2. As this is written the F.D.2 delta-wing research aircraft (pilot, Peter Twiss, D.S.C.) holds the world's speed record of 1,132 m.p.h. set up on March 10 last. This figure exceeds by no less than 37 per cent the previous record established by a North American Super Sabre of the U.S.A.F. The F.D.2, two examples of which are flying, is powered by a single Rolls-Royce Avon turbojet with reheat. Appraising the F.D.2 and its astounding achievement, the Technical Editor wrote in *Flight* of March 23: "Initial F.D.2 work came to fruition in 1950-1. The first concept of the aircraft was that it should be a transonic research machine, but it was deliberately given the thinnest possible wing for possible exploration beyond the 'sonic barrier.' To a great extent the company were working in the dark, and tunnel hours went into four figures before the shape was finalized. Particularly heavy design-loads were imposed by the undercarriage stowage (solved by employing a sophisticated design in very-high-tensile steel, the provision of duplicated powered controls (without manual reversion), the necessity to employ very thick skins and heavy forgings, and the need to carry fuel in the razor-like wing (which, in fact, has yet to show a leak)." The record is a tribute not only to the F.D.2's superb aerodynamic and structural design but, in particular, to its excellence of control and the flying skill of its pilot, for the conditions under which the flights were observed were stringent in the extreme.

Perhaps the most astonishing design feature of the F.D.2 is the hydraulic hinging of the fuselage behind the cockpit, permitting the nose to be lowered, drawbridge-wise, to provide the pilot with sufficient view on landing. The control surfaces comprise ailerons, elevators and rudder, all being fully powered by Fairey Hydroboosters.



Powerplant ...	Rolls-Royce Avon
Span	27ft
Length	52ft

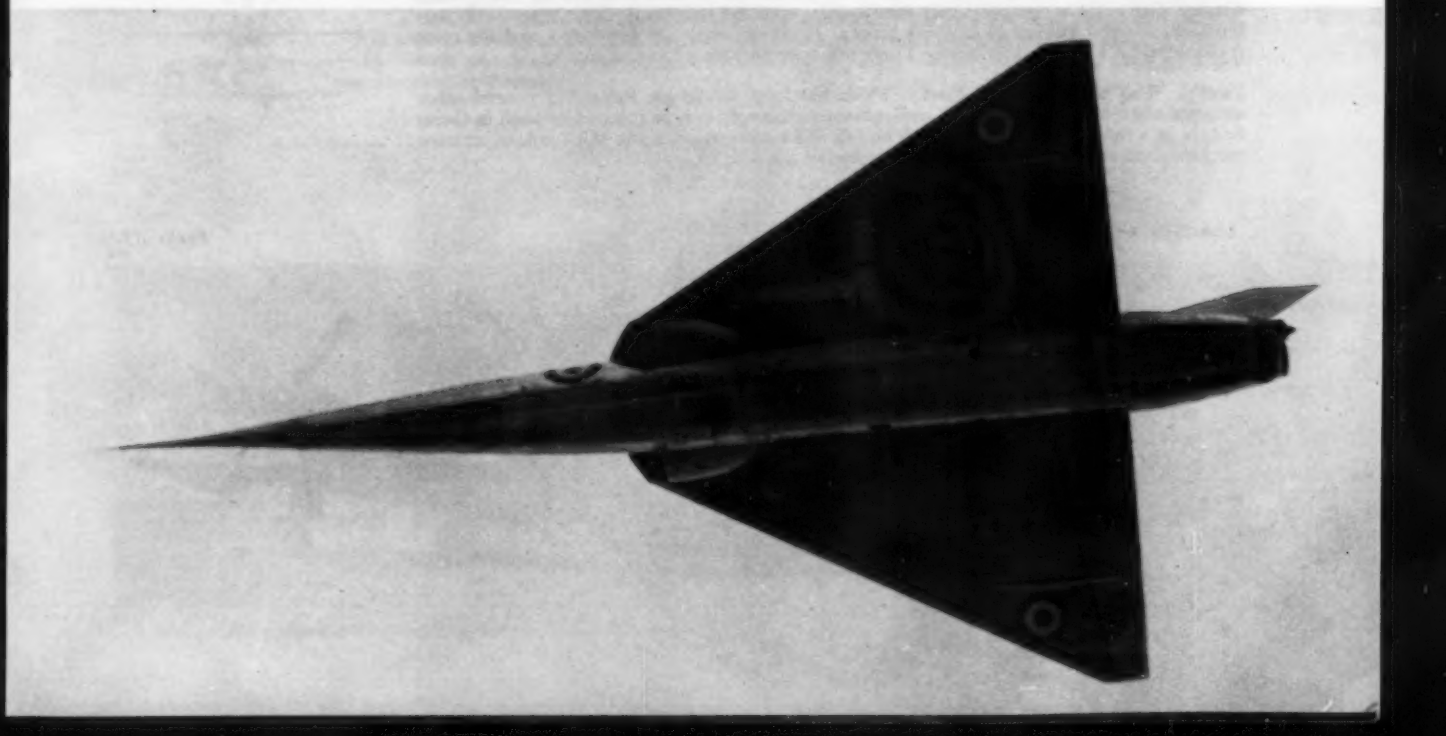
Photograph and drawing show F.D.2.

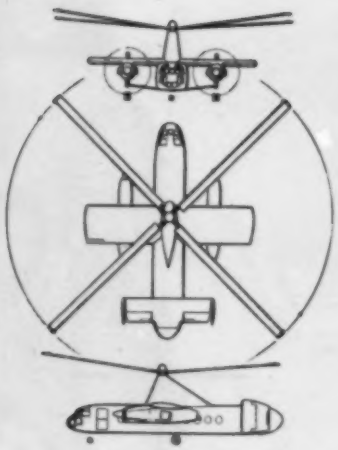
Rotodyne. Fairey's new helicopter, which at a gross weight of some 39,000 lb will be one of the largest and heaviest in the world, is a new kind of air-transport vehicle. It combines the best of both fixed- and rotary-wing worlds, and its capabilities may be visualized from the fact that it is a machine of 3,000 cu ft unobstructed capacity and a five-ton payload, capable of rising and descending vertically as well as of flying level as fast as, or faster than, a Douglas DC-3.

The essence of this remarkable aircraft is a single lifting rotor, a fixed wing and two airscrews, driven by two Napier Eland turboprops. Each Eland is arranged to feed compressed fresh air to the rotor. At take-off nearly all the power is absorbed in supplying the rotor with this air, which feeds kerosine-burning pressure jets at the tips of the four blades. Forward movement is then achieved by tilting the rotor axis, until, at about 100 kt, power is gradually transferred to the airscrews. The Rotodyne is then cruising solely on the thrust of the latter, with the rotor auto-rotating. This process is reversed for landing.

The 90ft four-blade rotor is worthy of special mention. Because of temperature considerations, it is made entirely of steel, and the design is such that its life will be at least equal to that of the rest of the airframe. Rotor speed can be varied independently of engine r.p.m., since, of course, there is no mechanical coupling, and yaw control is by differential use of airscrew pitch by means of a special rudder-pedal linkage.

Standard seat rails are provided in the cabin for 10 or 11 rows of four seats at 36in pitch,





in line with large, elliptical windows. At the front a big door, with integral steps, is fitted on the port side. Many types of interior have been planned. On the score of noise (a factor which cannot be ignored with tip pressure-jets) it is estimated that this will not be worse than 95 decibels at 200ft, which is less than that of many existing transports. Operating cost is one of the Rotodyne's most attractive features: typical figures for a 100-mile stage are 2.8d per seat-mile, which compares with 14d for a larger, twin-rotor machine, and 17d for a typical single-rotor helicopter. The prototype, which will weigh 33,000 lb, is due to fly early in 1957, and construction work is in progress on the second aircraft. This latter will have a gross weight of 39,000 lb, and an appreciably longer and deeper cabin. The first aircraft will be powered by Eland NEL3s rated at 2,800 s.h.p. plus 500 lb thrust. The second Rotodyne will start off with Elands at the higher NEL7 rating of 3,250 s.h.p., plus 650 lb thrust. Later a version of the 4,000-h.p. NEL4 or 5 will be fitted.

Powerplant	Two Napier Eland NEL3
Rotor diam	90ft
Fuselage length	58ft 8in
Gross weight	33,000 lb

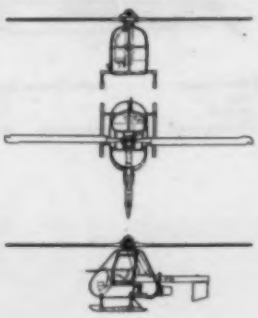
Drawing, artist's impression and data are for the first Rotodyne.

Ultra-Light Helicopter. It has long been appreciated that a type of helicopter could be developed specifically for Army requirements which would be invaluable for those many duties which the small fixed-wing utility aeroplane cannot tackle, yet which would be considerably cheaper than the larger types of helicopter. The primary rôle of the Fairey Ultra-Light would be that of an air observation post, with provision for equipment for the secondary rôles of casualty evacuation, training, and the countless other utility rôles—civil and military—which only the helicopter can perform. The machine employs tip-jet drive, a form of propulsion of which the Fairey Company have lengthy experience. The jet at the extremity of each blade is fed with compressed air by a Blackburn-Turboméca Palouste, which has an oversize centrifugal compressor for this purpose, and fuel is burned in each nozzle. The rotor is comparatively small—28ft—and the two blades form a see-saw combination, without individual flapping hinges. No drag hinges are employed, and the rotor is mounted on a fully tilting head. There are seats for two people.

Powerplant ...	Blackburn-Turboméca Palouste
Rotor diam	28ft 3in

(Performance data not yet available)

Drawing below and photograph at lower left show Ultra-Light helicopter.



Firefly. The piston-engined Firefly, which has long served the Royal Navy—and other air arms—as a fighter/attack and anti-submarine aircraft, is now principally used in Great Britain as a radio-controlled target. The Mk 8 is a conversion of the Mk 7 anti-submarine machine, and the U.9 is a similar conversion of the Mk 5.

Ultra-Light helicopter.

Firefly U.9.

Gnat (prototype).

FOLLAND AIRCRAFT, LTD.

Sydney Lodge, Hamble, Hants. Telephone: Hamble 3191

Gnat. The Gnat is a light fighter and ground-attack aircraft, designed round the Bristol Orpheus turbojet. Six examples have been ordered by the Ministry of Supply and we reported in June this year that jigs were being erected as fast as space became available in order that 20-30 machines a month might be built without increasing available resources. Keen interest, it was then stated, had already been shown in the Gnat by India, Finland, Holland, Belgium, New Zealand, Germany, Yugoslavia, Switzerland and Israel, and the Royal Canadian and United States Navies had investigated a carrier-borne version known as the Sea Gnat. It was stated last April that discussions concerning the sale of Gnats and their manufacture overseas were in progress with more than six countries. Up to that time 25 pilots—many from abroad—had flown the prototype, to a total of over 150 hr.

Capable of being built at a fraction of the cost of a so-called "conventional" fighter, the Gnat is claimed to be able to perform most operations which might be demanded from a single-seat day fighter of far greater size and weight, and, of course, cost. The characteristic setting of the wing in the high position and the horizontal tail surfaces in the low position is claimed to confer the advantage that excessive down-wash from the wing does not strike the tailplane during turns and other manœuvres and thus destroy its stabilizing effect. An extremely high rate of roll is conferred by the inboard ailerons without imposing any undue twisting forces on the wing. The air brakes are in the form of metal fairings attached directly to the three legs of the undercarriage. Armament is two 30 mm Aden guns, the barrels of which are in the air-intake fairings. Standard equipment includes VHF radio and standby, gyro gunsight and radar ranging, supplementary oxygen, braking parachute and lightweight, fully automatic ejection seat. As an intercepter the Gnat can climb to 40,000ft in little more than three minutes, and readily attains supersonic speed in a shallow dive. Reference has been made in the foreign press to a Gnat 2 intercepter having Orpheus with reheat and weighing less than 10,500 lb all-up. This would have a wing of 6 per cent thickness.

Gnat (for Ministry of Supply).

Powerplant	...	...	Bristol Orpheus
Span	...	...	22ft 2in
Length	...	...	29ft

GLOSTER AIRCRAFT CO., LTD.

Gloucester, Glos. Telephone: Gloucester 66294

Javelin. The physical characteristics of the Javelin delta-wing two-seat all-weather fighter (two Armstrong Siddeley Sapphires) have been familiar for some five years past. Little was known of its operational qualities, however, until the first visit to a Javelin squadron was permitted in July this year. The assurance was forthcoming on that occasion that the Javelin is light and pleasant on the controls. The ailerons are fully powered and the elevator and rudder are hydraulically assisted. Tailplane incidence is variable by an electric motor and is screw-jack controlled from a switch on the control column. Any degree of air-brake extension can be selected and the large comb-like braking surfaces, which extend above and below each wing, were reported to be extremely effective. Provision is made for pressure-refuelling through a single connection at the port wing root, and capacity is such that the length of a sortie was officially stated to be "considerably greater" than that of previous night fighters. Provision is made for two large auxiliary ventral tanks and these will probably double the endurance. The wide-track Dowty undercarriage and Maxaret equipment give excellent braking and control on the ground both during landing and taxying. Single-engined flight would appear to present no problems and, because the engines are toed in, and lie very close to the centre-line, the large rudder tab should be sufficient to trim out full power on one engine right down to minimum flying speed.

Variants in service are the FAW.1 and FAW.4, which are superficially similar. The latest mark is the FAW.7, which appears to have Armstrong Siddeley Sapphires of increased (possibly five-figure) thrust. A dual-control trainer version is being developed by Air Service Training, Ltd., but a project for a supersonic thin-winged Olympus-powered fighter has now been shelved. Current marks are armed with four 30 mm Aden guns and, according to an official statement, the Javelin is intended to carry guided missiles.

Powerplant	Two Armstrong Siddeley Sapphire
Span	52ft
Length	57ft

Photograph and drawing above show Javelin FAW.1

Javelin FAW.7

- **Increased Performance**
- **Greater Payload and Range**
- **Proven Reliability**

Based on the experience gained in the Pembroke, of many thousands of hours military flying in all climates.

ACCOMMODATION 6/12 passengers, in forward or rearward facing seats, their luggage and a crew of two, with full radio aids.

RANGE Carrying 12 passengers, a stage length of 600 nautical miles (1112 kms.) may be flown with reserve fuel for a 200 nautical mile (370 kms.) diversion, and 15 minutes stand-off at 5000 ft. (1525 m.). Alternatively, with maximum fuel including 100 gallons (227 litres) in external tanks, a stage length of 1075 nautical miles (1990 kms.) can be achieved with similar allowances.

PERFORMANCE Take-off distance to 50 ft. (15.25 m.) 2250 ft. (686 m.). Cruising speeds 142-193 kts. (264-357 km./hr.). Single engine take-off rate of climb 210 ft./min. (1.07 m./sec.)

VERSATILITY The spacious fuselage is readily equipped for vertical and oblique photography, or for air ambulance, freight or executive travel versions.

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Victor. The production version of the Victor B.1 bomber is barely distinguishable from the first prototype—a tribute to the basic "rightness" of the design. In detail, however, the two aircraft differ greatly. The production machine is powered by four very advanced Armstrong Siddeley Sapphire turbojets. The fuselage has been lengthened and the vertical tail is of notably cleaner design, with a much smaller root intake and a revised form of "acorn" at the junction of fin and tailplane. Additional transparent areas have been added in the roof of the flight deck, and subtle changes are discernible in the modelling of the intakes, the fuselage profile and the crescent wing. The filling and grinding of all external surfaces, coupled with the employment of sandwich-type construction, give the Victor an exceptionally smooth surface. There are many removable panels in the dorsal surface of the fuselage, which doubtless admit the grab of a crane for the loading of weapons. Beneath the cockpit floor is an exceedingly large dielectric area and in the rear fuselage is a corresponding area. Together these are presumed to serve an advanced radar bombing system. Stick aerials project from above and below the rear fuselage, and a small fixed tailplane is fitted to act as a bumper.

The design philosophy underlying the Victor's crescent wing has frequently been expounded in *Flight*. It may be recalled here that the outermost panels of the wing have "droop-snoot" leading-edge flaps, each in two sections; the rearward-moving trailing-edge flaps are shaped to the jet-nacelle contours, and there are large hinged air-brake panels on the tail cone to increase drag for deceleration in flight and upon landing. The powered controls have progressive feel simulation. Internal bomb capacity is obviously very great and additional bombs may be carried in streamlined containers beneath the wings.

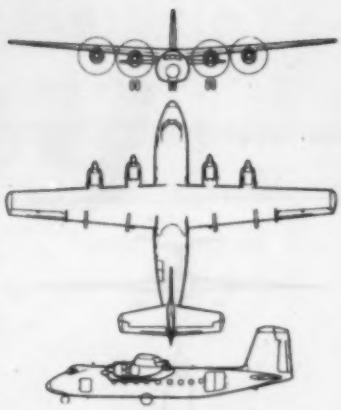
The installation of Rolls-Royce Conway by-pass engines is probably intended, with a view to improving the already-notable range. Of the present Victor the Supply Minister has said, "So far as we can judge, when the Victor gets into the hands of the R.A.F. it will be the equal in hitting power of any bomber in the world." Deliveries are imminent.

Powerplant	**Four Armstrong Siddeley Sapphire**
Span	110ft
Length	114ft 11in

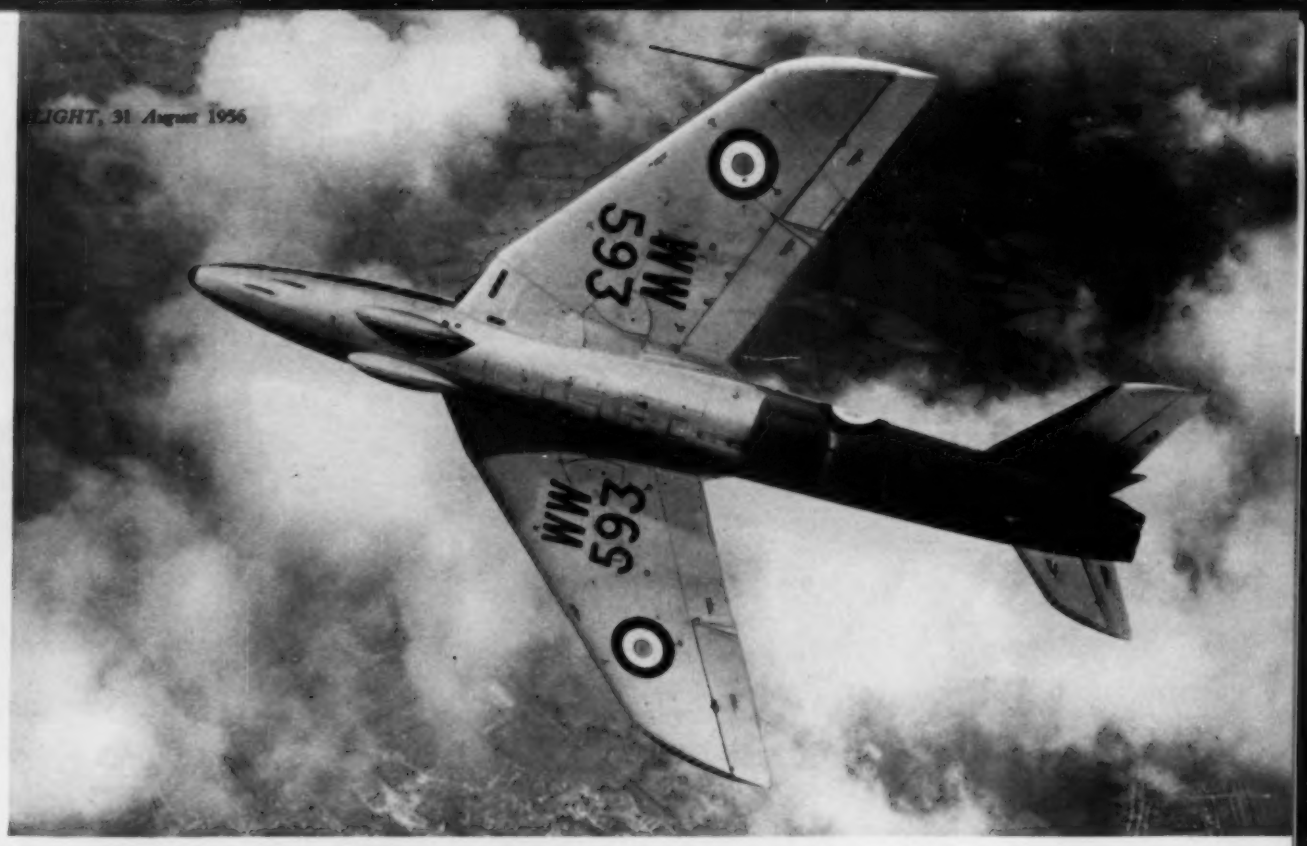
Herald. If there is one class of transport aeroplane which the world at present needs more than any other it is a vehicle which can perform the multitudinous duties which continue to fall to obsolescent aircraft—primarily, of course, the Douglas DC-3, or Dakota. It is, as many designers have found, extremely difficult to synthesize in one design all those many features which operators of fast-deteriorating equipment require in addition to providing performance and equipment to conform with present-day airworthiness standards. All this, however, has been achieved in the Herald, the design of which was the result of probably the most intensive operational study of its kind ever made. Handley Page conducted an exhaustive survey of local service- and short-haul operators in all parts of the world before the design was laid out in 1952. The first prototype flew just before last year's S.B.A.C. display, since which time it has completed the greater part of its trials. A second Herald, closely representative of the production version, is being shown at this year's display, and to this aircraft will fall the final phase of the certification tests. (A special-category C. of A. has, incidentally, recently been awarded.) Tropical trials will be given first priority, and when these are completed by the coming spring, the Herald will have reached the threshold of its operational career. Route trials are already planned for next summer, and this will probably be undertaken by the first purchaser to sign a contract for Heralds, the British independent airline, Air Kruise.

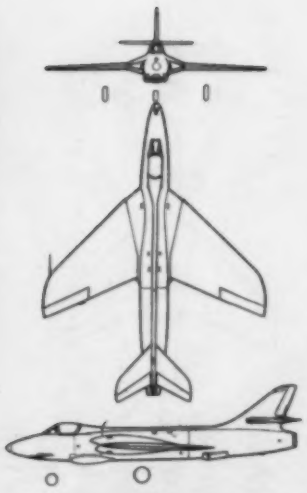
A key feature of the Herald is the use of four engines, giving a high reserve of power for short-strip operations. Piston engines were chosen after careful study of all the most likely power units as being the type with which out-station personnel would be most familiar. The engines are 850-h.p. Alvis Leonides Majors—the "Major" being virtually a "double" version of the widely used single-bank Leonides—and airscrews are by de Havilland. The powerplants are provided with generous accessibility by petal-type cowlings. The cabin is pressurized to a differential of 3.35 lb/sq in and the cabin-air system is supplied by two Godfrey blowers, one of which is driven by each outboard engine. Total fuel capacity is 700 gal, with provision for a further 150 gal if required. A simple hydraulic system powers the usual services, and the main electrical system is operated at 28 volts; the inner engines drive 6 kW generators and the outers 7.5 kVA. Ice protection is thermal, by exhaust-heated ram-air, with the exception of airscrews which are electrically de-iced. Most operations will require a crew of two only, though provision for a third crew-member is made in the cockpit. The aircraft can quite easily be flown solo for ferrying purposes. The unobstructed cabin provides seating for up to at least 44 passengers, and a movable bulkhead separates passengers from the freight-deck at the rear. This latter is accessible through a large entry door. When used solely as a freighter the Herald offers a usable volume of 1,575 cu ft.

Production at Woodley, Handley Page's Herald headquarters, of 100 aircraft is planned, and Air Kruise will be the first customer to receive delivery, in 1958.



Powerplant	**Four Alvis Leonides Major**
Span	94ft 9¼in
Length	70ft 3in
Gross weight	37,500 lb
Max. cont. cruising speed	248 m.p.h.





Powerplant Rolls-Royce Avon or Armstrong Siddeley Sapphire
Span 33ft 8in
Length 45ft 3in

Photograph shows Hunter F.6; drawing is typical of earlier marks.

HAWKER AIRCRAFT, LTD.

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Hunter Fighter and Fighter/Bomber. The family of Hunters is still increasing, so it may be helpful to set out its geneology. The Hunter F.1 was the original version, first flown in July 1951 and powered by a Rolls-Royce Avon; F.1s have been extensively supplied to the R.A.F. The F.2 is similar in structure, armament and equipment, but has an Armstrong Siddeley Sapphire instead of an Avon. The F.1 and F.2 were succeeded on the production lines by the F.4 and F.5. The F.4 has an Avon engine but, unlike the F.1, has increased fuel capacity in the wings and is able to carry under-wing stores, including auxiliary tanks. The F.5 is similar except that it has the Sapphire engine. The Hunter F.6 has a later version of the Avon, said to be of five-figure thrust, which confers a higher rate of climb and superior ceiling. It is distinguishable by its enlarged tailpipe and may eventually be fitted with an all-flying tail. All Hunter single-seaters have a built-in armament of four 30 mm Aden guns, provided with about 100 rounds each, made up as a quick-change pack. This is used in conjunction with automatic gun-ranging radar contained in the forward fuselage. The scanner is in the extreme nose, enclosed by a laminated plastic radome. Being linked with the gyro gunsight, the radar provides automatic ranging, and is controlled by a twist-grip on the power lever. A version is being developed—with a view to export—to carry Fairey Fireflash guided weapons, and another has been fitted experimentally with a thrust reverser. All recent Hunters have provision for 100-gal pylon-mounted finless plastic under-wing fuel tanks of Bristol manufacture, and possible ordnance loads are 24 rocket projectiles mounted outboard of the under-wing tanks, or two 1,000 lb streamlined bombs. Although incapable of supersonic speed in level flight, the Hunter F.4 achieves this with ease in a shallow dive. All-round performance and handling characteristics are of a high order and the machine is very much a "pilot's aeroplane." It is notable, too, for its short "turn-round" time after an operational sortie, and *Flight* representatives have watched a Hunter ground crew remove the gun panels; detach the barrels; lower the gun pack on to a special trolley; replace the barrels; winch up a new re-armed pack weighing some 1,900 lb; re-charge the oxygen bottles; change cine-film; and completely refuel the aircraft, all in an elapsed time of 5 min 42 sec.

Another representative of this journal, visiting Germany earlier this year, reported that Hunter pilots were happy with their aircraft and that the stoppage rate in gun-firing was very low (there had previously been criticism of the Hunter's armament). Cartridge-ejection, he said, gave no trouble and maintenance problems were said to be less than those on the Sabre. He reported also that many pilots considered that since four or five hits from 30 mm shells would destroy any aircraft, there was a case for using only two of the Hunter's guns at a time instead of four. With two guns in reserve double the firing time was available to the pilot, who might find a second target in the same sortie.

Hunters are serving with great success in a number of overseas air forces, notably those of the Netherlands, Denmark, Peru and Sweden.

Hunter with external stores.

Hunter Two-Seater. The photograph below discloses that since the previous S.B.A.C. Display the Hunter Two-Seater (R.A.F. designation Hunter T.7) has been somewhat revised. Note that the fairing behind the cockpit is now larger and of modified contour. Aft of the intakes the basic structure is identical with that of the Mk 4, though forward of this point the nose is entirely new. The cockpit has two gun-sights and two Martin-Baker lightweight ejector seats, and, as will be seen, the canopy is a notably fine example of plastic moulding. Beneath the cockpit are streamlined fairings for two 30 mm Aden guns, and in this connection it may be remarked that the makers foresee that the Hunter Two-Seater will be used not only as a trainer but will "open up opportunities for even wider tactical rôles." Thus, the Hunter is in the very forefront of a modern trend—particularly discernible in the U.S.A.—of developing operational two-seater versions of basic single-seater designs. Certainly the NATO countries should find much to interest them in this fast, tractable and versatile Hunter.

Powerplant	...	Rolls-Royce Avon
Span	...	33ft 8in
Length	...	48ft 10½in

Drawing and photograph at left show Hunter Two-Seater

Hawker Siddeley Group

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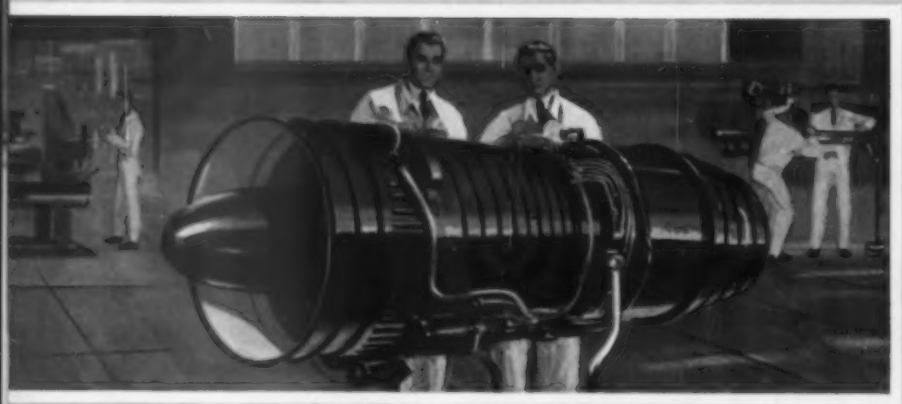
AIR SERVICE TRAINING
The Aircraft Division manufacture components for the Javelin, and for the Javelin Trainer conversion which they have designed. They are also engaged in the installation of the Fireflash in the Hunter. The Training Division specialise in basic flying and technical instruction on helicopters and fixed-wing aircraft, and in the training of Radio/Radar Officers and Aircraft Maintenance Engineers.



GUIDED MISSILES
The vital task of design, development, testing and production of guided missiles is undertaken by Armstrong Whitworth. The Company is now completing a new £1 million expansion programme designed to rebuild and equip one of the most modern research and design establishments in the country for aircraft and guided missile work.

SAPPHIRE TURBO-JET
The world's most successful turbo-jet, the Armstrong Siddeley Sapphire is the power plant for the Javelin, the Victor, the P.1 and the Hunter 5. It also powers nine foreign aircraft. The latest type test figure to be announced is 10,500 lb. dry thrust, but it is known that more powerful versions have been running for some time.

GLOSTER JAVELIN
With its speed, range, powerful radar and heavy armament the Gloster Javelin, now in squadron service with the Royal Air Force, holds the key to Britain's — and Europe's — atomic defence system. Fair weather or foul this formidable all-weather interceptor can be at 50,000 feet within minutes, ready to give a disconcerting welcome to sneak atomic attackers.

THE SEA HAWK
In service with the Fleet Air Arm and with the NATO forces,
and in long-term production by Armstrong Whitworth,
the Sea Hawk has the most formidable striking power.
This long-range carrier-borne fighter is fast,
easy to fly and easy to land on the flight deck.
Completely versatile, it is equally effective as a land-based aircraft.

AVRO VULCAN
Now going into service with the Royal Air Force
the Avro Vulcan, powered by Bristol Olympus Engines
is the world's first 4-jet delta bomber. A triumph
for British aviation it marks a strong lead
in aeronautical progress. Capable
of carrying a big punch a long way,
it has exceptional performance
at high sub-sonic speeds.

AVRO SHACKLETON MARK 3
Currently in production for R.A.F. Coastal Command
and for the South African Air Force,
the Avro Shackleton Mark 3 is the world's
most powerful sub-hunter. With its great ocean range, sensitive
search and detection apparatus and formidable weapon array,
the Shackleton is a powerful protector of vital sea lanes.

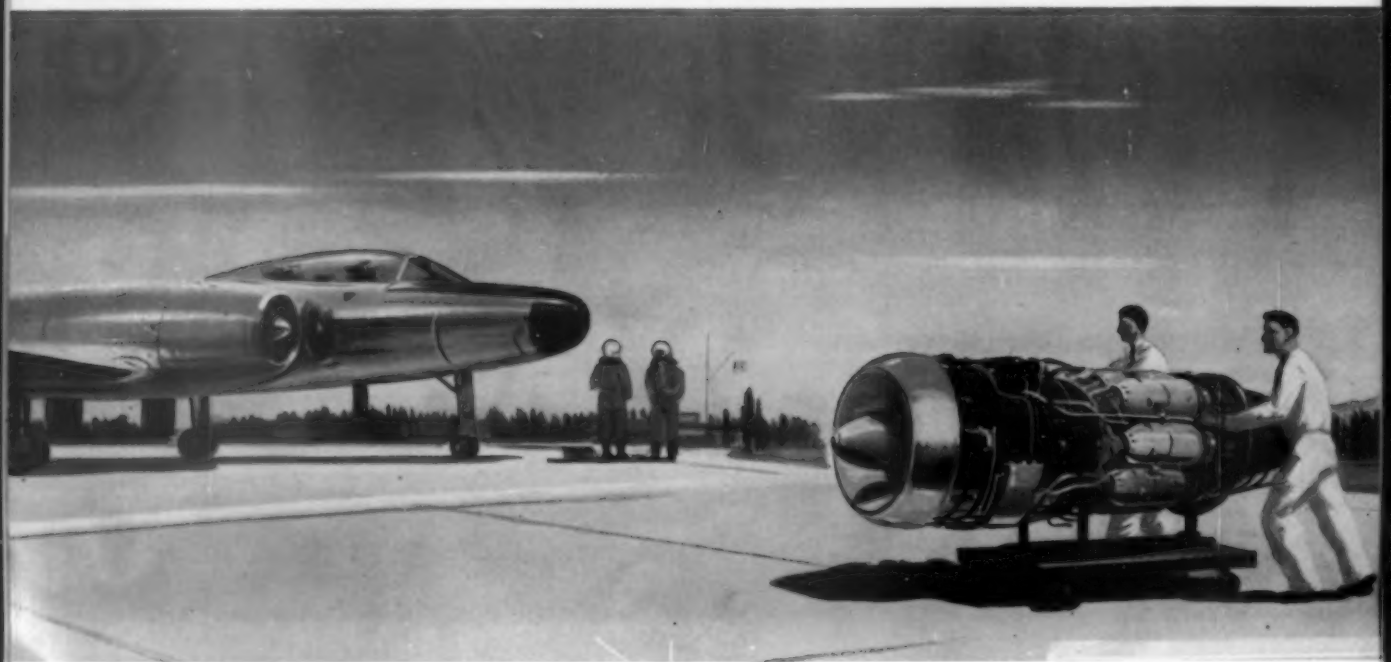
HAWKER HUNTER

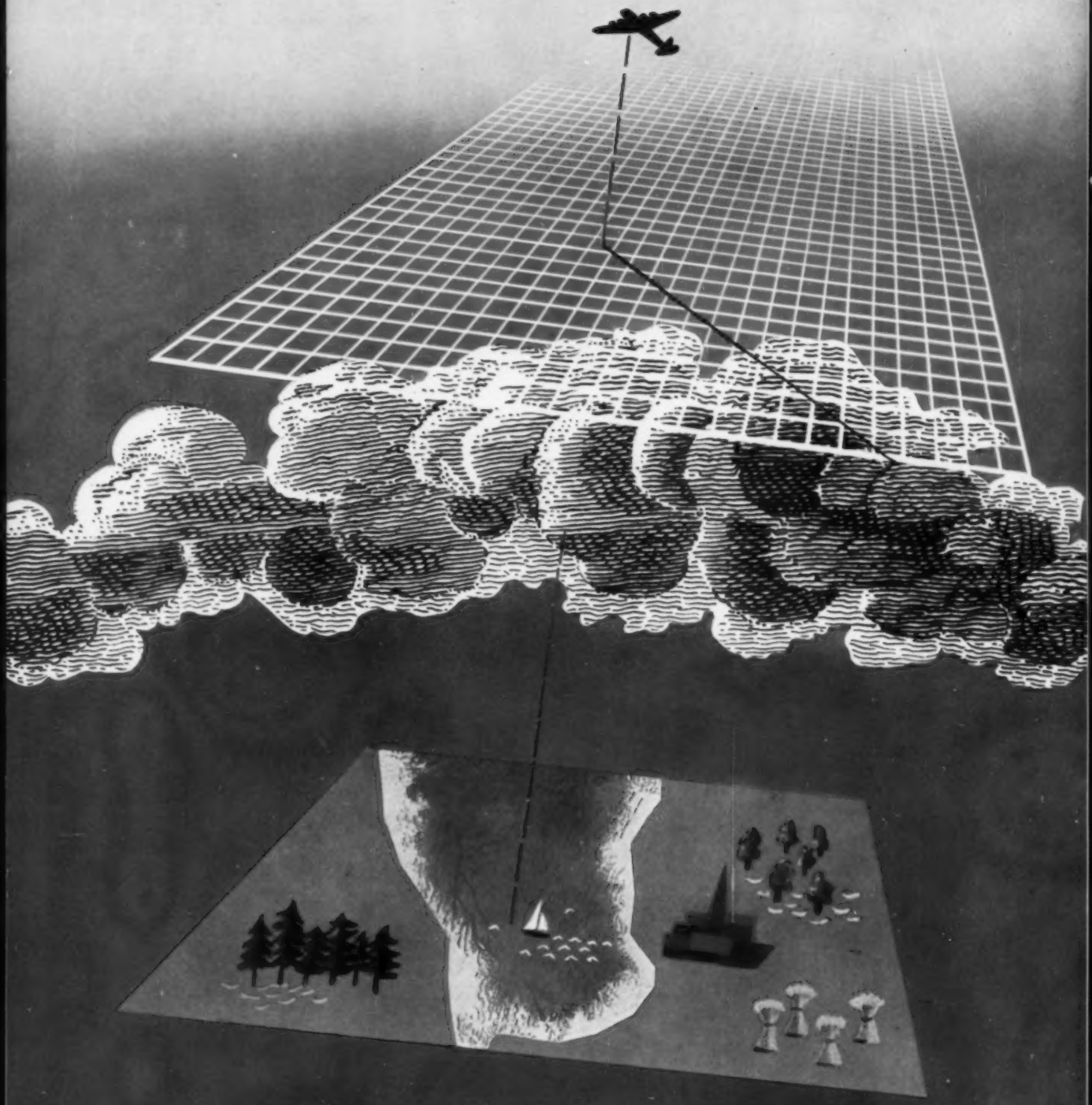
Backbone of Western Europe's Defence System the Hawker Hunter is in service with the Royal Air Force and with the air forces of NATO, Holland, Belgium, Sweden, Denmark and Peru. Illustrated here are the Hunter Mark 4, Hunter Mark 6 with uprated Rolls Royce Turbo-jet and the Hunter Two-seater which opens up even wider tactical roles. The Hunter is one of the most versatile fighters flying in the West today.

A. V. ROE, CANADA

Canada's first line of defence the CF-100 long-range all-weather fighter is designed and built by Avro Aircraft for the Royal Canadian Air Force. Speed, range, heavy fire power and the ability to operate over vast terrain in extremes of climate make the CF-100 a formidable weapon in protecting the freedom of Canada. Power for the CF-100 is provided by the Orenda turbo-jet – designed and built by the Orenda Engines Ltd. One of the most powerful engines ever to go into service the Orenda also powers all U.S. and Canadian Air Force Sabres flying in Europe.

Now under development by the A. V. Roe Canada Group are the CF-105 delta wing all-weather super-sonic fighter which will be powered by Orenda Engines' brand new Iroquois turbo-jet. Details of both are still secret.





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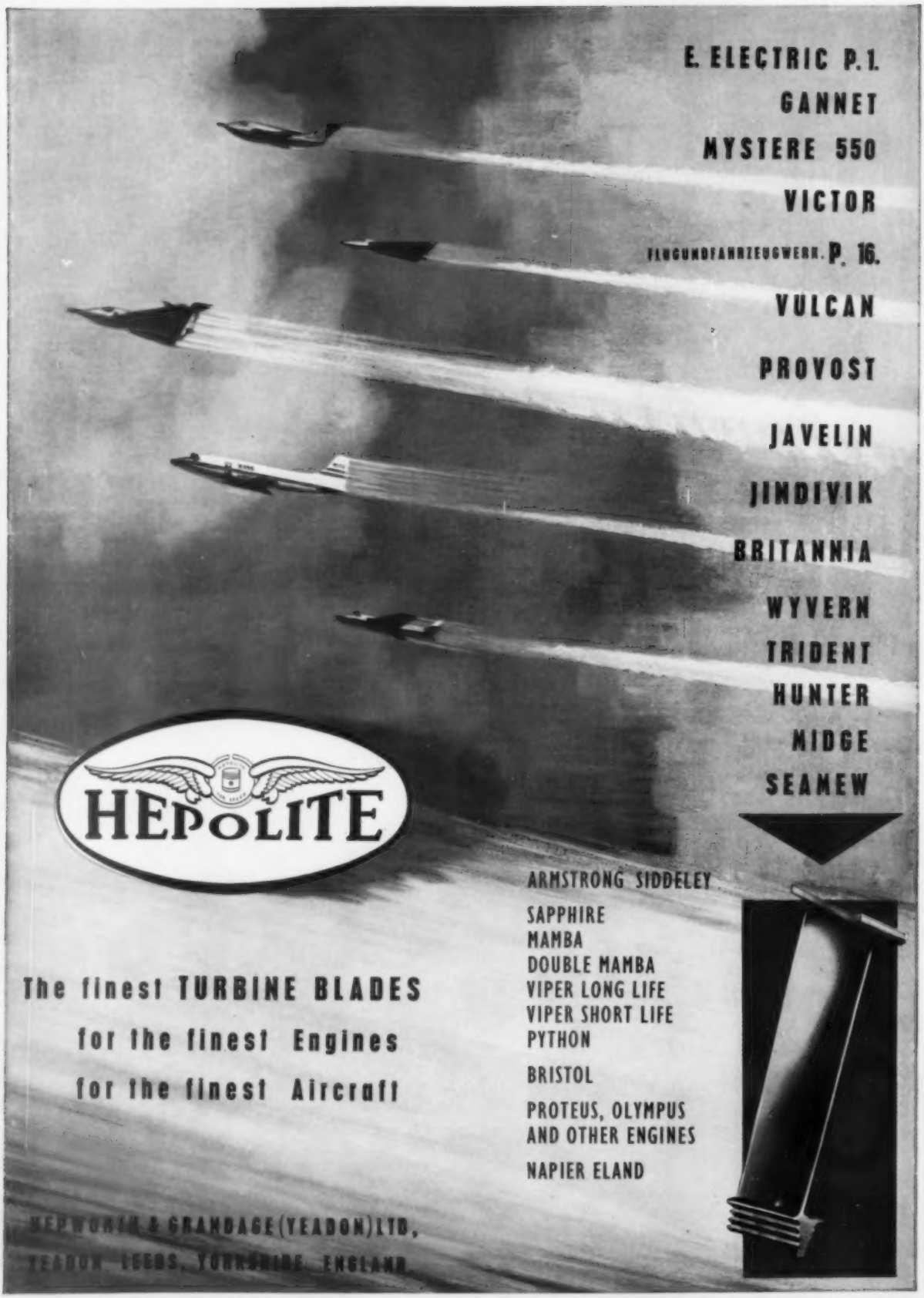

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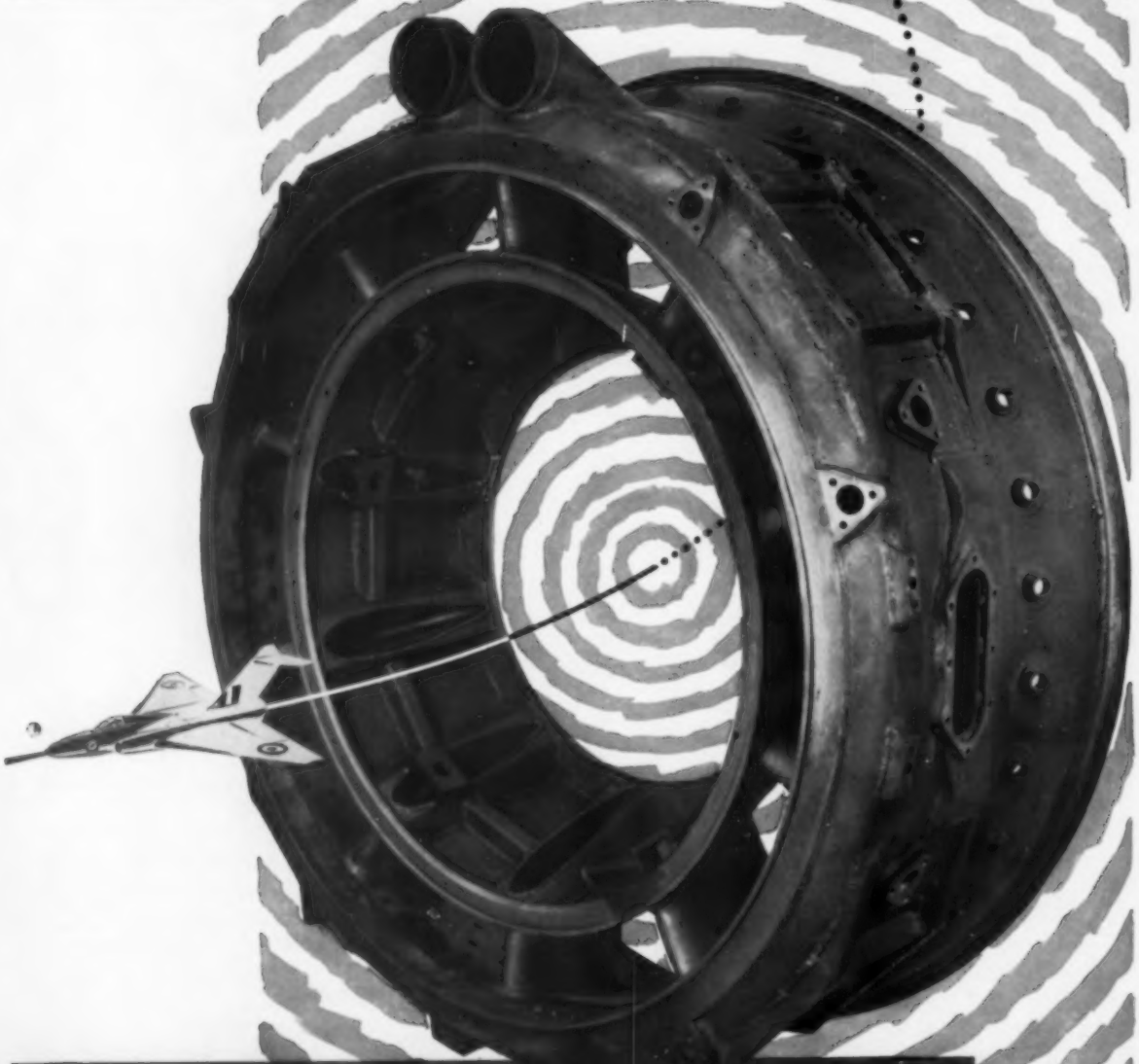

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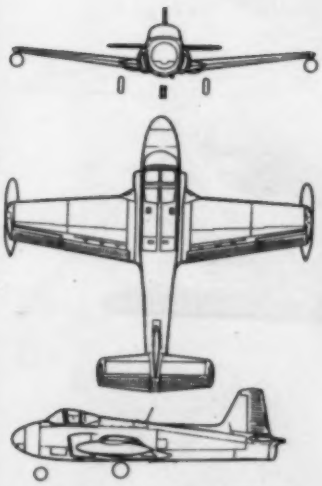


Powerplant	**Armstrong Siddeley Viper ASV.8**
Span	35ft 5in
Length	31ft 11in
Gross weight ...	6,050 lb
Max. speed	330 m.p.h.

Drawing and photograph show Jet Provost T.2

Jet Provost. The classic example of the "translation" of a highly successful piston-engined trainer into a truly modern jet-propelled machine for similar duties, the Jet Provost is now in use at R.A.F. Hullavington for the initial training of pupil-pilot courses. Very encouraging results have been achieved.

The Jet Provost was conceived as a basic jet trainer which would retain the truly excellent handling qualities of the piston-engined Provost T.1 while achieving the higher performance and particular characteristics of the jet aircraft. The Armstrong Siddeley Viper was available with the required thrust and was selected for installation. The machines at Hullavington, and a number sent elsewhere for official R.A.F. and foreign evaluation, were based as closely as possible on the piston-engined version; but the success of the initial venture justified a modification programme which has resulted in the T.2 version, a prototype of which was demonstrated last year. The Jet Provost T.2 takes advantage of the extra 110 lb thrust of the Viper ASV.8 and has a cleaned-up rear fuselage contour and slightly enlarged jet pipe. The long-legged nosewheel undercarriage of the Mk 1, the main units of which were directly adapted from those of the piston-engined Provost, has been replaced by a shortened gear; and pneumatically operated systems are now superseded by hydraulics in the interests of simplicity and servicing. Flap span has been increased to give greater area, and the cockpit enclosure is being changed to take full advantage of the field of vision allowed by the short nose.

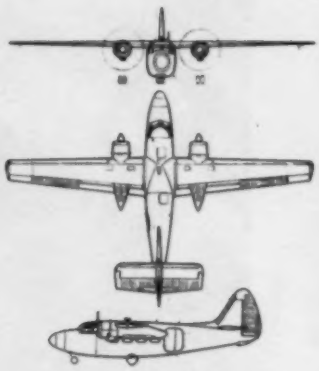
Over 2,000 hours have been logged by Jet Provost T.1s, and this experience has already resulted in a number of detailed alterations in cockpit layout suggested by the training authorities who have evaluated the machine. These authorities have been able to recommend a basic flying training course of 167 hours before transition to advanced aircraft, for a final 70 hours to "wings" standard, as compared with the present 120 hours each on Provost and Vampire. Though the initial training now costs more, the transference of 47 hours of advanced training to the basic stage results in a very substantial overall cost saving. Average time to solo for pupils without previous flying experience has been 11.25 hr on Jet Provost; and it has proved possible to achieve a preliminary instrument flying standard within the first 20 hr solo flying, which enables pupils to fly through eight-eighths cloud and thereby to take advantage of the jet's increased endurance at higher altitudes at an early stage in their training.

M

President. It would have been difficult to bestow a more fitting name on this civil development of the Pembroke, for Hunting Percival foresee it especially as an executive aircraft. In this form, indeed, it will make its first appearance in the S.B.A.C. Display this year. The aircraft is equally attractive as a feeder-liner, or for charter work, for which operation it can be fitted with up to 12 seats. The aircraft has scope, too, as a freighter and for special work such as photographic survey—this being the form in which a number of the President's Prince forebears are operating. The President is actually the civilian counterpart of the military Pembroke, and is backed by six years of military flying with the R.A.F., Fleet Air Arm, and other forces. A useful commercial attribute is the unusual capaciousness of the cabin—unusual at least for an aircraft of this size: the cabin is a completely unobstructed volume measuring 20ft by 5ft 6in wide by 6ft 1in high, with a door 5ft 2in high by 4ft 2in wide close to the ground. The two Alvis Leonides engines have been extensively proved in service all over the world, particularly in the arduous training rôle (e.g., as fitted to the Provost), and the President's short-field performance, particularly on one engine, is remarkably good.

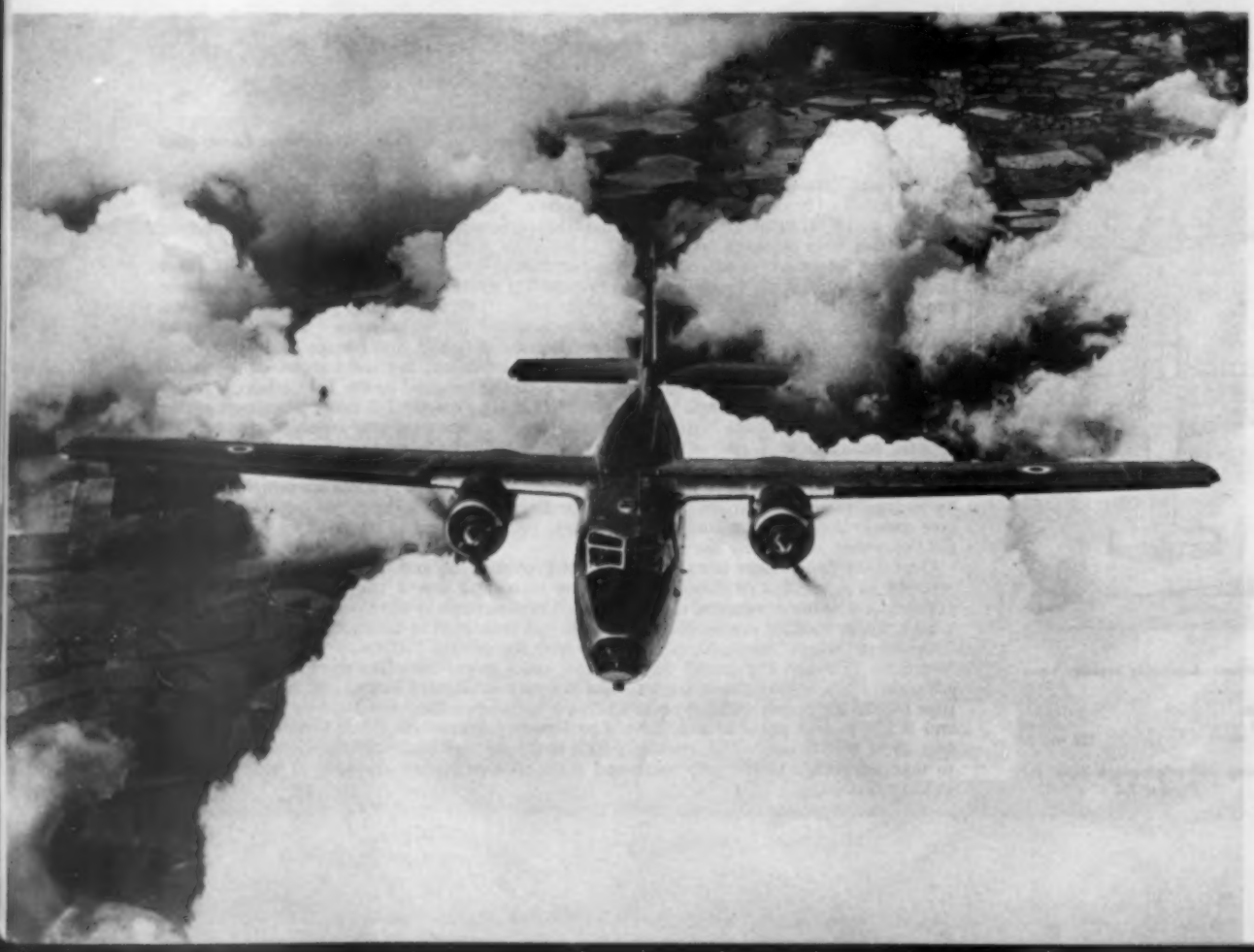
The total usable fuel capacity of the President, with the S.B.A.C. allowances, gives a still-air range of 1,030 statute miles at an economical cruising speed of 150 m.p.h. This distance can be increased to 1,500 statute miles by the fitting of underwing slipper tanks. Over shorter distances the President can maintain a speed of up to 220 m.p.h. at maximum rich-mixture settings and has a service ceiling of 22,000ft.

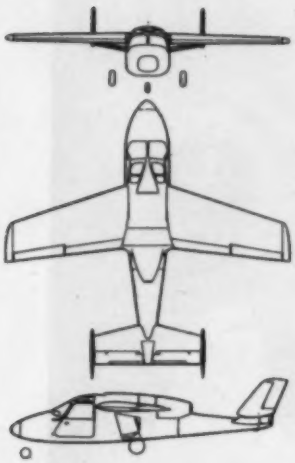
Pembroke. The Pembroke is a general-purpose military transport able to operate at full load from small—and even unprepared—airfields in climates as diverse as those of Finland, Aden and Malaya. With up to ten rearward-facing seats it is used for communications work or for freighting. The cabin space (seats removed) measures 20ft 1in in length, 5ft 6in in width, and 6ft in height. For the dropping of supplies—for which the removal of the two main doors leaves an opening 4ft 2in wide and 5ft 2in high—the Pembroke is well suited. Casualty evacuation is yet another application, for which the machine is fitted with six stretchers; and for multi-engine pilot-training, dual controls and amber screens can be installed. With a forward-facing oblique camera in a transparent nose the Pembroke becomes a survey machine of notable merit. There is provision, too, for vertical and side-facing oblique cameras in the cabin. As a flying classroom it carries radar or radio operators, bomb-aimers or navigators, with appropriate equipment. The makers take especial pride in the Pembroke's performance on one engine. In the event of a failure on take-off it will get away on one Leonides and, in the cruise configuration, with flaps and undercarriage retracted, will cruise at full load on one engine at maximum continuous power up to heights of over 6,000ft.



Powerplant ...	... Alvis Leonides
Span	... ... 64ft 6in
Length	... ... 46ft
Gross weight ...	... ... 12,800 lb
Max. speed ...	... 220 m.p.h.

Drawing and data for Pembroke C.1; photograph is of Survey Pembroke



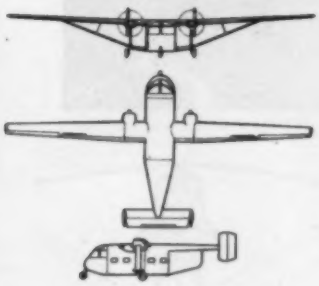


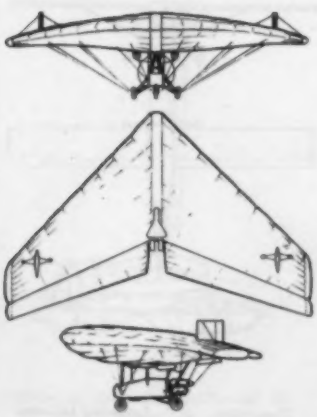
Powerplant ...	Blackburn Marboré 2
Span	28ft
Length	27ft
Gross weight ...	3,100/3,600 lb
Max. speed	302 m.p.h.

Drawing and photograph of model above show Student

Powerplant	Two Lycoming GO-480
Span	75ft 4in
Length	37ft 10in
Gross weight ...	8,000 lb
Max. speed	158 m.p.h.

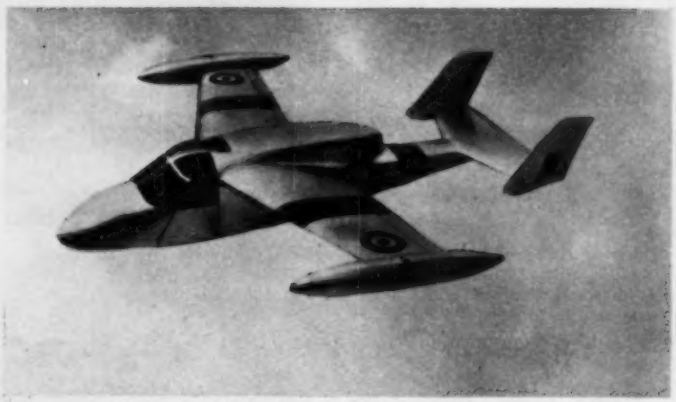
Drawing below shows H.D.M.106





Powerplant ...	Walter Mikron III
Span	35ft
Length	23ft 3in
Gross weight	935 lb
Max. speed	68 m.p.h.

Drawing above and photograph at right show M.L. Light Aircraft Mk 1



F. G. MILES, LTD.

Shoreham Airport, Shoreham-by-Sea, Sussex. Telephone: Shoreham-by-Sea 2301

Student. Offered with the Blackburn Marboré 2 or Continental J69 turbojet as standard powerplant, or—alternatively—with two Blackburn Palas 600s, the Miles M.100 Student is a general-purpose light jet trainer. Already a version, designated Mk 3, is foreseen with either a Rolls-Royce or a Turboméca turbojet of approximately 1,400 lb static thrust. The Student can operate either as an elementary trainer, with limited navigational and radio equipment, or as a basic trainer, with approximately 400 lb of additional equipment. The unorthodox layout of the machine can be studied in our general-arrangement drawing. The makers claim that it is suitable alternatively as a four-seat communications aeroplane with a range of over 400 miles, and in emergency it could be adapted for ground support. In the latter connection the light wing loading and extraordinarily wide field of view would be particularly valuable assets.

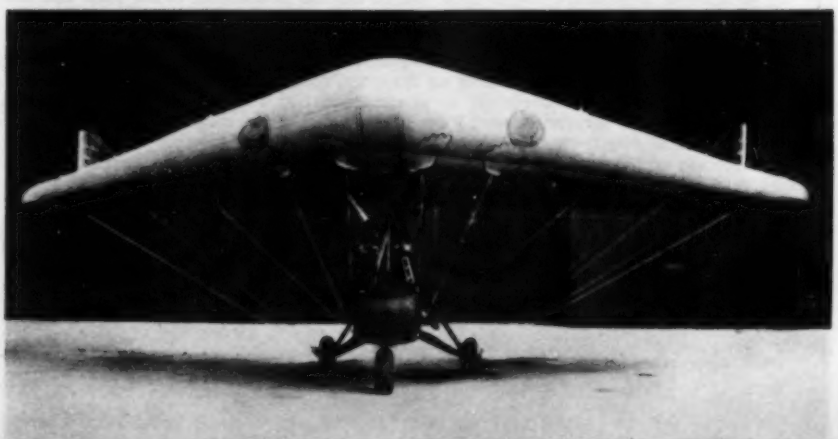
The makers believe the entry and exit arrangements on the M.100 to be better than those on any other trainer in the world. Larger-than-car doors open directly on to the seats and the floor of the aircraft is only 8in above ground level. It is, in fact, possible to sit directly on to the seat from the ground.

H.D.M.106. An experimental prototype of this interesting new transport project is now being constructed by Miles at their aerodrome factory at Shoreham. It is an Anglo-French venture, the initials H.D.M. signifying Hurel-Dubois and Miles. The idea was to conjoin the aerodynamic advantages of the high aspect ratio wing (in which, of course, Hurel-Dubois excel) with a small but capacious fuselage (15 passengers or a ton-and-a-half of freight) with big rearward-opening doors, thus combining in a small vehicle the commercial advantages of freighting as well as passenger-carrying. In its initial (H.D.M.105) experimental form—in which it will fly next year—the aircraft will be a Miles Aerovan modified to take a new high aspect ratio wing of 75ft span.

M. L. AVIATION CO., LTD.

White Waltham, Berks. Telephone: Littlewick Green 248

M.L. Mk 1. The commercial and military usefulness of an aeroplane which can be packed when not in use into a very small space needs no emphasis, and the M.L. company's success in the design and testing of their remarkable inflatable rubber-wing aeroplane is of real significance. The prototype of a year ago has now been considerably refined and cleaned up, and the rubberized-fabric wing, of delta plan form, no longer presents the "quilted mattress" appearance of the original. Inflation, at the modest figure of 1 lb/sq in, is now by electric pump instead of by a windmill. Control is by inflated elevons. The fuselage has been completely redesigned and has tandem seating for a pilot and a passenger.



EDGAR PERCIVAL AIRCRAFT, LTD.

Stapleford Tawney Aerodrome, Abridge, Essex. Telephone: Theydon Bois 2321

E.P.9. Good business awaits the aircraft designer who can offer to farmers an aeroplane designed from the outset to provide him with an implement not just for one or two aspects of agricultural work, but for all-round application. Today, the majority of the thousands of light aircraft used for agricultural work are adaptations of types designed for other purposes: an example is the Tiger Moth. A famous name in British aviation—that of Edgar Percival—has now returned to the scene of aviation design with the E.P.9. Mr. Percival first envisaged the aeroplane as an aerial top-dresser, particularly for operation in New Zealand; as a result of a prolonged study at first hand of agricultural aviation in that country, as well as in Australia, India, Malaya, Indonesia, and Fiji, he became convinced that there was wider scope for aircraft in farming than top-dressing alone. The result of his detailed market survey is the trim-looking machine depicted above. This prototype has been flying now for nine months. The configuration of the aircraft results in voluminous cargo space (total capacity, including pilot's compartment, is 235 cu ft, total floor area being 50ft); the cabin is loaded through either the clam-shell doors at the rear, or by way of a large side door. The floor is close to the ground, and such loads as 45-gal oil drums, wool bales, sheep, etc., can be loaded with ease. As a passenger aircraft the E.P.9 is a six-seater; and an important factor for top-dressing operation is that, when moving from one site to another, a ground crew of three can be carried in addition to the pilot and the hopper. Another good point, in view of the fact that agricultural flying is a relatively hazardous business, is that the pilot sits on a level which is above both the load and the engine. Further evidence of the careful thought that went into the making of the E.P.9 is to be found in the following words of its designer, made in the course of an interview with *Flight*: "Because I was designing an aircraft that had a more universal application than for fertilizing and spraying alone, I decided a metal stressed-skin was most suitable for agricultural and rough-country work; and because of the high-wing layout we were able to make use of light-alloy wing covering, since the fertilizer or spray chemicals were unlikely to come into contact with the wing.

"The fuselage has been made of steel tubing because this material appears to be the most suitable to combat the corrosive effect of some of the fertilizers and sprays used in agricultural work. With light-alloy skin-covered structures the corrosive effect of the fertilizers used is most marked at the lapped joints and under the rivets."

Powerplant ...	Lycoming GO-480-B1B
Span	43ft 6in
Length	30ft
Gross weight	3,415 lb
Max. speed	138 m.p.h.

Drawing, data and photograph for Skeeter 6

Powerplant	...	D.H. Gipsy Major 201
Rotor diameter	...	32ft
Fuselage length	...	28ft 5in
Gross weight	...	2,150 lb
Cruising speed	...	99 m.p.h.

SAUNDERS-ROE, LTD.

Osborne, East Cowes, Isle of Wight. Telephone: Cowes 2211

Skeeter. Development of this light helicopter has now been in hand for a number of years and the work carried out, first by the Cierva Company and then by Saunders-Roe, has resulted in the Mk 6 civil version, the Mk 10 military A.O.P. machine and the Mk II military trainer. The Mk 6 is a derivative of the Mk 2 which first flew in October 1949, powered by the de Havilland Gipsy Major of 145 h.p. The following Marks 3B and 4 were intended for military use and were fitted with the 180 h.p. Blackburn Cirrus Bombardier 702. Development proceeded through the civil Mk 5 to the Mk 6 which incorporates a considerable number of improvements in equipment and design, and is powered by the 200 h.p. de Havilland Gipsy Major 201. Full dual controls are fitted, permitting the machine to be used as a trainer, but the seats are individually removable and a long-range tank may be fitted in place of the seat normally used by the observer. If required, this seat can be reversed to give a rearward view for A.O.P. work. The engine is installed transversely, the drive being taken from the rear end of the crankshaft on the starboard side. Fan cooling is provided through a starboard intake. In present versions the blades consist of a wooden secondary structure bonded to a steel tubular spar, the whole being covered with fabric; the leading edge has plywood covering. In May last year a pre-production order was placed for three A.O.P. machines and one trainer for the R.A.F. After evaluation by the R.A.F. and Army a production order for an unspecified number of military Skeeters was placed towards the end of July this year. The number of machines concerned was not stated. They are destined for the A.O.P. squadrons provided by the R.A.F. for operation with the Army. The pilots will be Army personnel and Skeeters will probably be integrated with existing "fixed-wing" A.O.P. flights. All the Army machines at present on order will be equipped for immediate adaptation for dual control. Both the Skeeter and its engine have considerable development ahead of them. New, more efficient all-metal rotor blades will be fitted and the Gipsy Major 200 engine is likely eventually to produce up to 250 h.p.

SR.53. Prototypes are under construction of this supersonic turbojet-plus-rocket interceptor. Although no details have been officially divulged, it has been reported that the rocket is a de Havilland Spectre and the turbojets may be Armstrong Siddeley Vipers.

SCOTTISH AVIATION, LTD.

Prestwick Airport, Ayrshire, Scotland. Telephone: Prestwick 79888

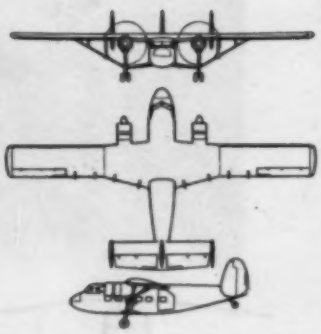
Prestwick Pioneer. Those who have seen the Pioneer perform at previous S.B.A.C. Displays have been astonished at the way in which this light transport almost rivals the helicopter in its short take-off and landing performance. It was, in fact, designed to a specification which required, primarily for Service use, a front-line communications and liaison aircraft which could be operated from small, rough strips not exceeding 100 yd. The specification called further for steep angles of approach and climb, and for an ability to withstand long periods left out in the open with the minimum of unskilled maintenance. The Pioneer met these requirements handsomely, and has proved its value with the R.A.F. operating from small jungle clearings in Malaya. The take-off run, fully loaded, is 75 yd, or 180 yd to clear a 50ft obstacle, and landing performance is equally impressive. The significance of this order of performance to commercial operators is obvious, and the Pioneer's success encouraged Scottish Aviation not only to offer a civil version, but also to develop a larger-capacity twin-engined machine. This is described below.

Twin Pioneer. In this "double" development of the Pioneer Scottish Aviation have combined the remarkable field performance of the smaller machine with a commercial load of 16 passengers. It is true to say that no other aircraft than this, be it fixed-wing or rotary-wing, is able to fly 16 people off 250-yd strips (actual distance to unstick take-off run is 100 yd) for distances of up to 500 miles at a cost per passenger of three-halfpence a mile. The Twin Pioneer represents, in fact, an entirely new class of air transport vehicle and its attractions have become a factor of significance in the equipment policies of a large number of operators. It is clear that an aircraft of this type, and larger-capacity developments, could, despite relatively low cruising speed, offer some remarkable city centre-to-city centre times, as well as bringing the benefits of air transport to communities in areas where prepared airfields do not abound. The Twin Pioneer's interior is unobstructed by structural members and is 19ft long with a headroom of 5ft 8in. Large rectangular windows, coupled with the high-wing arrangement, provide an excellent view. The first prototype has been flying since June 1955, having now flown more than 300 hr, and it was joined last April by a second machine. Others are approaching completion. All have been built in production jigs, and preparations are in hand at Prestwick for a run of 200 aircraft. Projects exist for a floatplane version, and for a freighter development.

Turbo-Pioneer. Bearing this designation is a projected 40-passenger machine powered by two turboprops.

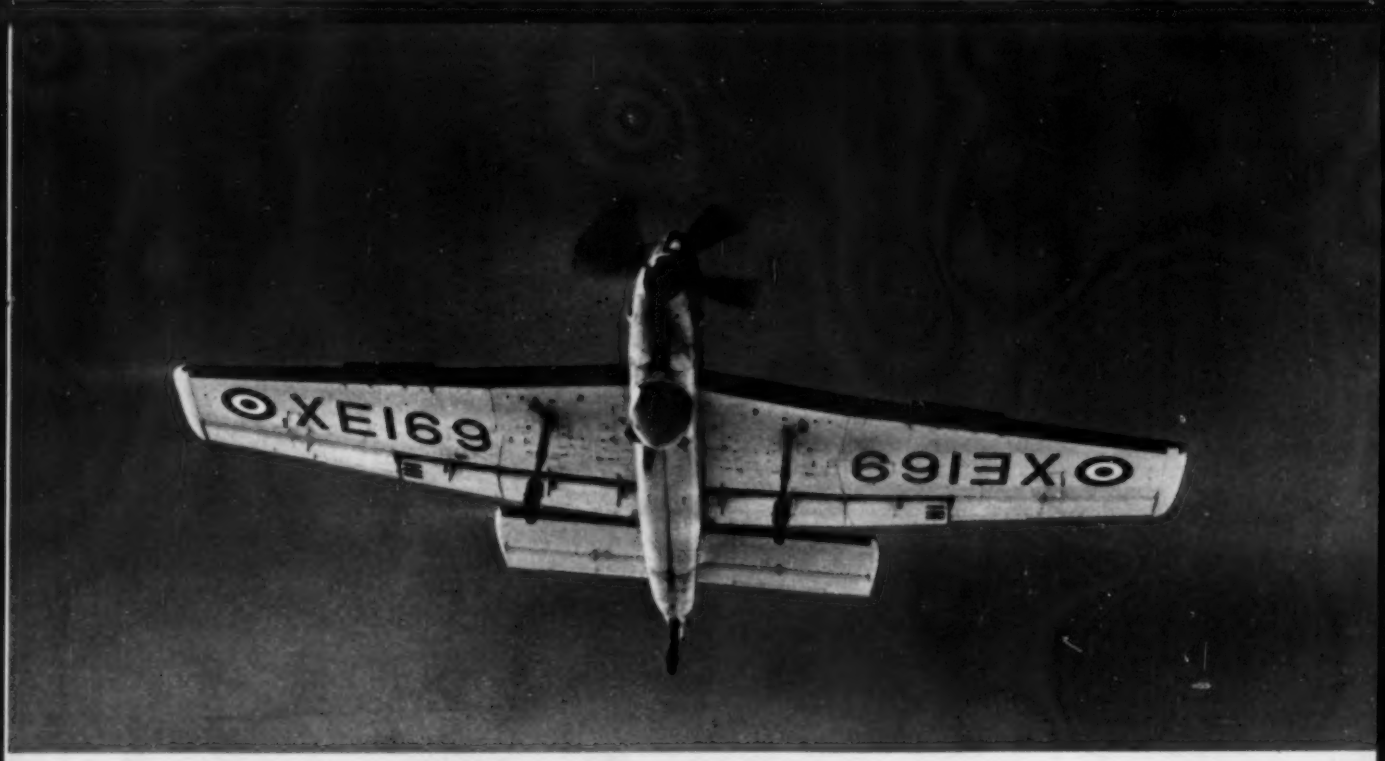
Powerplant ...	**Alvis Leonides 502/4**
Span	49ft 9in
Length	34ft 4½in
Gross weight	5,800 lb
Max. speed	162 m.p.h.

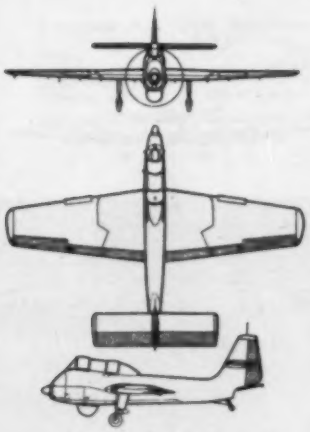
Photograph and drawing above show Prestwick Pioneer



Powerplant ...	**Two Alvis Leonides 503/3**
Span	76ft 6in
Length	45ft 3in
Gross weight	13,500 lb
Max. speed	167 m.p.h.

Drawing above and photograph below show Twin Pioneer





Powerplant ...	Armstrong deley ASM.6	5 1 d - Mambas
Span		55ft
Length		41ft
Typical gross weight (A.S.1)		13,884 lb
Max. speed		242 m.p.h.

SHORT BROTHERS AND HARLAND, LTD.

Seaplane Works, Queen's Island, Belfast. Telephone: Belfast 58444

Seamew. As supplied to the Fleet Air Arm of the Royal Navy the Seamew turboprop-powered light anti-submarine aircraft is designated A.S.1; for R.A.F. Coastal Command its name carries the suffix M.R.2. This unique aeroplane stems from Naval Staff deliberations in 1951, which concluded that there was a need for a simple, yet fully effective, light aircraft for anti-submarine duties. Take-off performance in a 12 kt wind is 500ft and even in still air it is only 300 yd. The total stores load is in excess of 1,800 lb, with some stores carried on the wings and some internally, and several combinations are possible, including mines, sonobuoys and torpedoes. The normal level speed of the aircraft is about 200 kt, but it is cleared to the relatively high diving speed of 325 kt; this is to enable attacks to be made from altitude by diving on the enemy. The speed range between stalling speed and diving speed is unusually large for an aircraft of this type. The forward position of the radar scanner ensures that, even in a steep dive, the target is always in the radar view and never blanked by the nose of the aircraft. Alternative weapons loads of the Seamew A.S.1, in its present form, are: four 275 lb anti-submarine bombs; two 275 lb A/S. bombs, four R.P.s and eight 28 lb sonobuoys; or 20 sonobuoys and six R.P.s. With an enlarged (17ft) weapons bay and fuel for a three-hour patrol, it is possible to carry six 275 lb A/S. bombs and three R.P.s, or one 2,000 lb "weapon" (this may be assumed to be a form of homing torpedo); or 28 sonobuoys and six R.P.s. No gun armament is carried for anti-submarine duties. The ASV radar is fully incorporated, with a rotating scanner housed within a prominent radome under the forward fuselage. With the exception of the indicator and the control unit, the whole of the gear is accommodated in a hinged bay for easy access. Other equipment includes VHF radio telephone, H.F./T.R. voice equipment, intercommunication equipment, low-level radio altimeter and a pilot-interpreted short-range navigational aid.

P.D.11. This very important vertical-take-off prototype is being built at Belfast to the order of the Ministry of Supply. No other details are available.

Seamew with folded wings

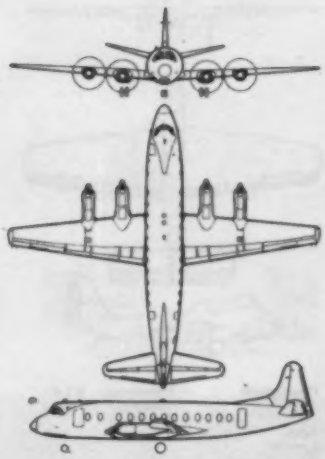
VICKERS-ARMSTRONGS (AIRCRAFT), LTD.

Weybridge, Surrey. Telephone: Byfleet 240

Viscount. The Viscount unquestionably represents one of the highest achievements of the British aircraft industry to date. No other British airliner has started so completely from nothing and gone on to make an impact on world air transport as great or greater than any other airliner before it. It has been bought by more than 30 airlines, and has radically improved the fortunes of the dozen operators with whom it is already in service. Nearly 350 have now been ordered, of which about 130 have already been delivered. The largest single order, for 75, has so far come from Capital Airlines in the U.S.A. Results achieved by this one operator during the first full year of its Viscount operations tell a story which is typical of the others—load factors around the 80 per cent mark, and a break-even percentage load factor in the fifties.

The Viscount of today, and particularly that of tomorrow, is very different from the prototype of 1948. The process of development has been largely one of exploiting the steadily increasing power of the remarkable Rolls-Royce Dart turboprop engine. Starting off at about 1,000 h.p., the Dart is today giving powers approaching double this figure, and as powers have increased so have the weight and load-carrying capacity and speed of the Viscount. The latest production aircraft operate at 63,000 lb compared with the 56,000 lb of the first B.E.A. production machines, and in July the forebear of a whole new family of larger, heavier and faster Viscounts—the first Series 800 aircraft—made its first flight. It is for developments of this version that most current orders are being placed. The chief changes introduced in this type are the introduction of Dart 520s (rated at 1,990 e.h.p.); a 46in stretch of fuselage and a moving-back of the aft pressure dome to give 111in of extra cabin length; and a general strengthening of the structure. The new Viscount family is designated 810/840, the second number denoting a further increase in engine cruising power which will achieve cruising speeds of 400 m.p.h., yet at a miles-per-gallon figure approximately the same as that of the earliest Viscounts, operating ten tons lighter and 100 m.p.h. slower. With the Viscount selling at a rate of about one aircraft every other day, Vickers have put in hand extensive plans for the doubling of total Weybridge and Hurn production capacity. Some idea of the effort being put into the Viscount programme may be gained from the fact that this expansion anticipates continued production for several years ahead at an annual rate substantially higher than the 89 planned for this year. Next year nearly 120 Viscounts will be delivered. Payload accommodation of the 700-series Viscount (the type currently being delivered) is for up to about 50 tourist passengers, variable according to requirements, while capacity of the later 800 series is increased to accommodate up to about 70 tourist passengers.

Vanguard. Short-haul air transport is a notoriously difficult field in which to make money, and the only way it can be exploited profitably—provided the traffic-flow exists—is with large-capacity aircraft operated at high frequencies and high load factors. It is this fact which inspired Vickers to design the Vanguard and, as might be expected, British European Airways—one of the world's most experienced short-haul carriers—played a big part in its



Powerplant	**...Four Rolls-Royce Dart**
Span	**94ft**
Length	**85ft 7in**
Gross weight	**... 67,500 lb**
Typical cruising speed ...	**365 m.p.h.**

Photograph shows Viscount 701; drawing shows Series 800; data are for Series 810

evolution. The Vanguard represents a reversal of the hitherto accepted principle that short-haul transport aircraft should be smaller than those for long-range operations. Yet although the Vanguard was primarily designed for sectors of less than 500 miles, it is able to carry its design maximum payload of 21,000 lb over stage-lengths of up to nearly 3,000 miles, and this flexibility of performance, coupled with a cruising speed of 400-425 m.p.h., makes its appeal an especially wide one. Perhaps its most valuable commercial attribute (and one which it shares with no other airliner) is that, by virtue of its massive cargo holds in the lower deck of its double-bubble fuselage, it can carry something like 85 per cent of its maximum payload with only a quarter of the passenger seats filled. This is a "something-for-nothing" extra which enables the aircraft to be filled up in off-peak periods to permit airlines to get the maximum utilization out of the aircraft in fluctuating seasonal traffic conditions. This facility is not offered at the expense of passenger-carrying capacity—the Vanguard will seat up to 115—nor for any substantial penalty in structure weight. The first point to be appreciated about the Vanguard, therefore, is its great capacity (greater than any airliner currently operating); and a second point is that it has been designed to use this capacity to the full, not only on short sectors, but on medium-range routes also. No less important is the fact that its turboprop power, supplied by four Rolls-Royce Tynes of exceptional efficiency, offers a level of economy over this wide band of ranges which no jet competitor can approach. Cost per passenger mile of the tourist version does not rise above 1.5 cents right down to ranges of 200 miles, while over 2,000-mile sectors this cost falls below 1.25 cents. Into the design, of course, has gone the unmatched combined experience of Vickers and Rolls-Royce with the Viscount. Production will be at Weybridge, where capacity is at present being enlarged, alongside the larger 800-Series Viscount. The company's capacity at its Hurn factory will continue to be filled with Viscount production. The design of the Vanguard has been described in detail in previous issues of *Flight*, in particular in our issues of June 1 and July 6.

The first Vanguard is scheduled to fly in the autumn of 1958. This aircraft, although not strictly a prototype (it is being constructed with production tools), will be retained by Vickers for tests and demonstrations. As already noted, the design was undertaken in particularly close partnership with British European Airways, and the Corporation formally signed the contract for 20 aircraft on July 20 at a price, including spares, of approximately £1m per aircraft. Originally, these machines were to have been of the early (now extinct) V.901 type, but all Vanguards will now be of the V.950 series, with increased range. First deliveries to B.E.A. are scheduled to begin in March 1960. The first aircraft will have the "stage one" Rolls-Royce Tyne, rated at 4,020 s.h.p.; "stage two" engines will be available in 1961 rated at 4,600 s.h.p., and the early engines will be converted to this standard. By early 1963 Rolls-Royce anticipate that the "stage three" Tyne should be in service, rated at some 5,000 s.h.p., permitting Vanguard cruising speeds of 425 m.p.h.

Powerplant	...	Four Rolls-Royce R.B.109 Tyne
Span	... ...	118ft
Length	... ...	122ft 4in
Gross weight	...	135,000 lb
Cruising speed	...	400/425 m.p.h.

Drawing above and photograph of model below show Vanguard

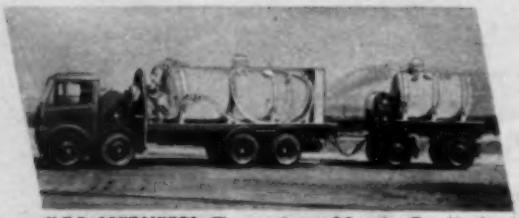
Valiant. The Valiant B.1, the first of the V-bombers to be supplied to the R.A.F. and now having many months of service to its credit, exists in at least three forms—the basic B.1 bomber, the B(PR).1 and the B(PR)K.1. As its designation denotes, the B(PR).1 is a photographic reconnaissance version of the bomber and can, in fact, be converted within an extremely short time to perform in the bomber rôle. External distinguishing features are the bomb-door windows, permitting vertical photography and two rear-fuselage windows for oblique photography. These modifications permit the aircraft to operate either as a long-range reconnaissance aircraft by day or night, or as a survey aircraft. The B(PR)K.1 is a tanker development, and is itself convertible for bomber and photographic reconnaissance duties. Many of the Valiant B.1s now in service are equipped for flight-refuelling and are distinguishable by the stump of a flight-refuelling probe in the nose and a ridge running alongside the canopy, presumed to be connected with the probe installation. All Valiants are fitted for under-wing tanks and ferrying tanks can be disposed in the bomb bay. The flying controls are fully powered, with manual reversion; artificial feel is provided by a mechanism in the tail, using dynamic pressure sensed from an intake at the root of the fin. Pressurization charge air is tapped from all four engines, and two settings are available, one for normal flight and the other—rather lower—for operational situations. An emergency system will give greatly increased flow to maintain some pressurization despite a puncture of the cabin wall. A normal Valiant crew consists of a captain, co-pilot, navigator/plotter, navigator/radar bomb-aimer and a signaller. All sit together in the pressurized nose cabin, the two pilots side by side in front, and the others facing rearwards below and behind them.

Powerplant	...	Four Rolls-Royce Avon
Span	...	114ft 4in
Length	...	108ft 3in

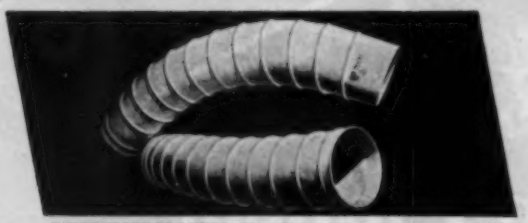
Photograph and drawing show Valiant B.1

SKEETER: The two-seat light helicopter which is in production for use with the British Army for A.O.P. and light liaison duties.

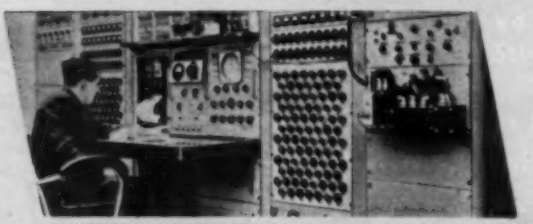
HYDRODYNAMIC TEST TANKS: The finest and most up-to-date research equipment of its kind in the world for the development of water-based aircraft and all types of marine craft.



H.T.P. CONTAINERS: The experience of Saunders-Roe (Anglesey) in the welding of aluminium is invaluable in the production of equipments for the manufacture, transport and storage of high test peroxide.



REINFORCED PLASTICS: Glass-fibre components of Saro Laminated Wood Products are in production for military and civil aircraft, notably the Vickers Viscount.



ELECTRONIC COMPUTERS: The Saunders-Roe Electronics Division specialises in the design of analogue computers and associated equipments for many purposes including the development of aircraft and guided missiles.

SR.53 MIXED UNIT INTERCEPTOR: Designed and built by Saunders-Roe, the SR.53 is powered by a gas-turbine engine and a rocket motor.

Positive versatility

A specialist has been defined as one who knows more and more about less and less until he knows everything about nothing. Conversely, the all-rounder is one who knows less and less about more and more until he knows nothing about everything. These are extremes and between them lies the centre of balance, the focal point of efficiency.

In the development of aviation the maximum contribution is made by the company which finds that focal point. It must fully exploit the variety of its talents but avoid deploying its resources beyond the point where practical development is possible for each.

The activities of the Saunders-Roe Group typify this positive versatility. At Farnborough you may see something of the variety of Saunders-Roe achievements and know that each is in continual practical application and is backed by full production facilities.

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for the

16 Passenger Twin Pioneer

Powered by Alvis Leonides Engines
—fitted with De Havilland propellers

A hundred yards, or so, of reasonably level ground is all that the Twin Pioneer needs.

It can land at bicycle speed in 100 yards; can take off in 85.

With its unlimited utility and 'put-down-any-place' performance, the Twin Pioneer can carry the countless benefits of air transport, simply and cheaply, to anywhere in the world.

150 yard Airstrip at Malayan jungle outpost, served by R.A.F. "Prestwick Pioneers" forerunners of the 16 passenger "Twin"

Scottish Aviation

PRESTWICK AIRPORT · AYRSHIRE

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Powerplant ...Two Rolls-Royce Avon
Span 37ft 2in
Length 55ft 4in

Photograph and drawing above show N.113

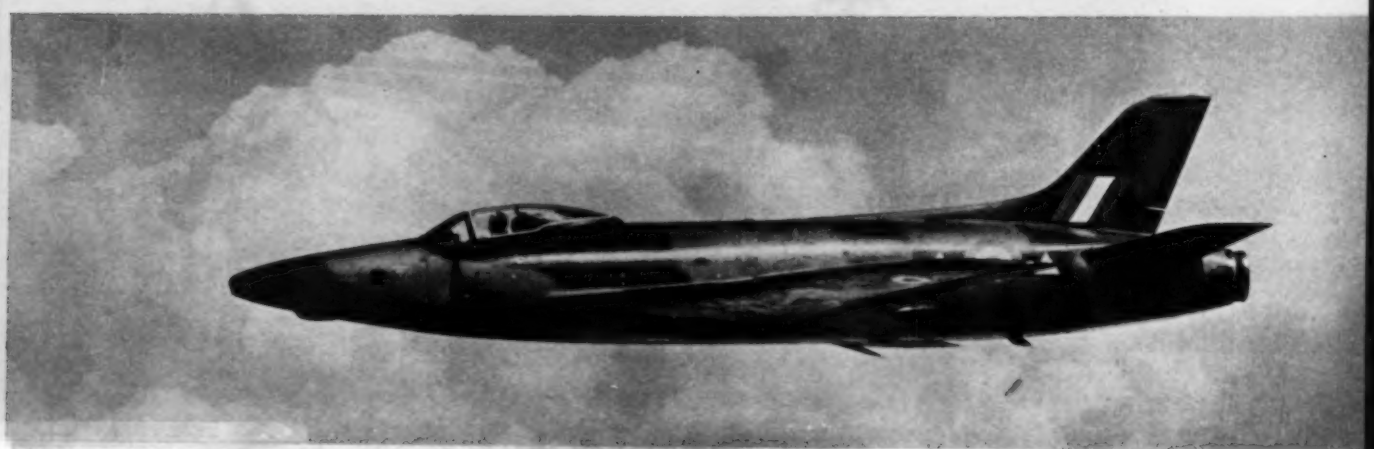
VICKERS-ARMSTRONGS (AIRCRAFT), LTD., SUPERMARINE WORKS

South Marston, Swindon, Wilts. Telephone: Swindon 3451

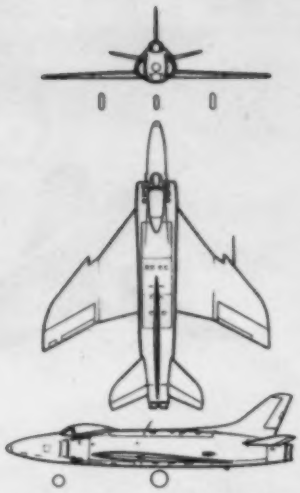
N.113. As yet unnamed, this twin-Avon single-seat fighter/bomber is the intended replacement in the Fleet Air Arm of the Royal Navy for the Hawker Sea Hawk. Production is already well advanced. The N.113 strongly resembles its forerunner, the Type 525, but has a longer, pointed, nose and—apparently—intakes of increased area, suggesting that the two laterally disposed Avons are of higher thrust than formerly. Afterburners are not fitted but a favourable thrust/weight ratio should be attained in view of the fact that each Avon is likely to have a five-figure thrust rating. Design features include a saw-tooth leading edge and an all-moving tail. Of particular interest is the "super-circulation" system whereby air ducted from the Avon compressors is blown over the upper surfaces of the flaps to increase lift by local acceleration of the air-flow. The first Service version of the N.113 will not carry guided weapons in addition to its four 30 mm Aden guns but a later version may have guided weapons as an alternative to the guns.

Swift. The Swift is principally used in the Royal Air Force as a fighter/reconnaissance aircraft, but the recently announced Mk 7 version is to be used for gaining experience with Fireflash guided weapons. In this connection it is of interest also that a Swift F.1 has been employed by de Havilland Propellers, Ltd., as an experimental missile-carrier. For fighter/reconnaissance duties the Swift F.R.5 is well equipped by virtue of its high speed at low level and the rapid acceleration conferred by the Rolls-Royce Avon turbojet with afterburner. Internal fuel capacity is great and a 220-gal jettisonable tank can be attached beneath the fuselage. The cockpit canopy is of a new clear-view type, and the armament has been reduced to two 30 mm guns. Three reconnaissance cameras are normally installed. A *Flight* representative visiting a Swift squadron in Germany earlier

Swift F.R.5



this year reported that the pilots were very happy with the aircraft and seemed to be converting to it from Meteors "without sweat or anxiety." The following extract from his report is of interest in emphasizing the operational importance of the Swift: "The Swift will rely largely on speed for immunity from ground defences. The new concept in the atomic age visualizes a short period of intense air activity, and the risks of atomic attack on troops in the battle line and on rear areas is such that, in the first phase, everything is staked on securing information of an atomic build-up in the tactical area. Relying on high speed for a silent approach and coming in over the tree tops below radar screens, the Swift should be virtually immune from engagement by ground forces. Swift pilots must be more than just good pilots. They must be good map-readers and able to find a pin-point and report on it quickly and accurately. The safety of the field forces will depend largely on the Swift squadrons. . . ."



Powerplant	...	Rolls-Royce Avon
Span	...	32ft 4in
Length	...	42ft 3in

Drawing shows Swift F.R.5

WESTLAND AIRCRAFT, LTD.

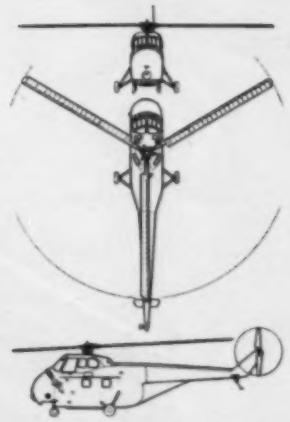
Yeovil, Somerset. Telephone: Yeovil 1100

Whirlwind. Although the Whirlwind general-purpose military and civil helicopter is known in many parts of the world with an American powerplant, it will shortly be available with the British Alvis Leonides Major as a standard fitment. With this unit it is known as the Whirlwind Mk 5. The prototype has been flying for about a year and has undergone extensive flight development trials during that period. The Leonides Major confers a notable improvement in load-carrying capacity and the hovering ceiling (with 10ft wheel clearance) is 9,000ft. The engine is installed in the extreme nose behind two clamshell doors and a simple operation enables it to be swivelled forwards and downwards to give ready access for servicing. The four-blade main rotor is of all-metal construction and the makers claim it to be completely immune to temperature and humidity effects. The blades are matched with a master blade and are individually interchangeable.

In this country the Whirlwind is best known as a military aircraft and is used by all three Armed Services, but a civil version can seat up to ten passengers with a crew of two. Civil Whirlwinds have been used by British European Airways for their service between London Airport and the South Bank and are now operating the Midland inter-city services of the same Corporation. Abroad, Whirlwinds are serving for survey and transport and for whale-spotting.

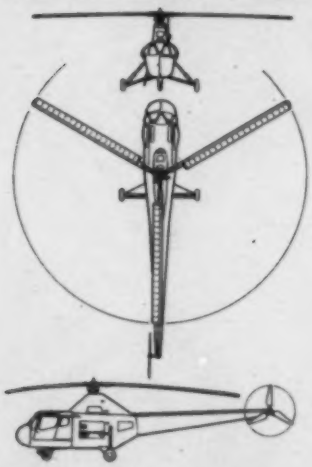
Widgeon. Typifying the versatility of the type, two Widgeon helicopters will participate in the S.B.A.C. Display this year, one a passenger version and the second an ambulance. The Widgeon is a private venture Dragonfly development and is now in production. The cabin section is entirely new and offers improved and additional seating arrangements; the flying-control system is likewise new and the c.g. range has been increased by the fitting of the offset flapping-hinge rotor hub of the larger Whirlwind. In the main, however, the well-tried features of the popular Dragonfly have been retained. The weight penalty of the new rotor hub has been almost exactly balanced by a weight saving in the new nose structure, if the Dragonfly and Widgeon are compared to the same standard. Thus the empty weights are approximately equal, and the increase in gross weight from 5,700 to 5,900 lb can be utilized almost entirely for the extra payload, which gives a civil five-seater. For military use, the most useful features of the Widgeon are (1) the ability to rescue a crew of three persons, using winch and crewman. (This was not possible in the standard Dragonfly due to the c.g. movement); (2) its possible use as an ambulance machine, carrying two standard general-service stretchers (loaded through the port nose-door) and medical attendant; (3) the side-by-side seating and dual control for pilot training.

Wessex. A recently announced project of the Westland company is the Wessex, a completely re-engineered version of the American Sikorsky S-58, scheduled to go into service with the Fleet Air Arm and with other branches of the Services and civil operators in 1958.



Powerplant	...	Alvis Leonides Major
Rotor diameter	...	53ft
Fuselage length	...	41ft 8½in
Gross weight	...	8,000 lb
Cruising speed	...	86 m.p.h.

Drawing shows Whirlwind Mk 5; photograph below shows earlier version

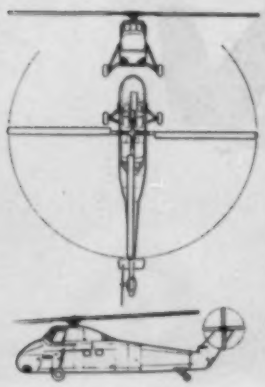


Powerplant	...	Alvis Leonides
Rotor diameter	...	49ft 2in
Fuselage length	...	41ft 2½in
Gross weight	...	5,900 lb
Cruising speed	...	80 m.p.h.

Drawing and photograph above show Widgeon

Though broadly based on the American machine, the Wessex will be largely redesigned to take a Napier Gazelle shaft-drive gas turbine which will, when it first flies, be giving well over 1,250 s.h.p. The American machine is powered by a Lycoming-built Wright R-1820-84 giving 1,525 h.p. and is in service with New York Airways, the U.S. Navy (HSS-1) and U.S. Army (H-34) as a civil transport, anti-submarine aircraft and transport respectively. These rôles are also projected for the Wessex. The designers have paid particular attention to simplicity, ease of maintenance and reliability and full dual control is to be provided to allow for training as well as operational work. The anti-submarine version, to be produced first, will carry a full complement of submarine detection devices and strike weapons, while other variants will be able to accommodate a crew of two and 12 passengers or eight litter cases. The four-blade main and tail rotors both have all-metal, fully interchangeable blades with a symmetrical aerofoil section and freedom of movement in both vertical and horizontal axes. Control is hydraulic servo-assisted. The undercarriage is unusual in having a tail-wheel well back along the tail, the final portion of which can itself be folded for carrier stowage. Recent extensions of the Westland factory are intended to accommodate Wessex design and production departments.

Westminster. The design of this big 40-seat helicopter is now in hand. Intended to meet a variety of military requirements, it will be powered by twin gas turbines, mounted on the cabin top and driving a single main rotor. All-up weight will be 33,000 lb, of which 13,000 lb will be available as disposable load.



Powerplant ... Napier Gazelle

Drawing and artist's impression show Wessex

Eon Olympia IV.

SAILPLANES

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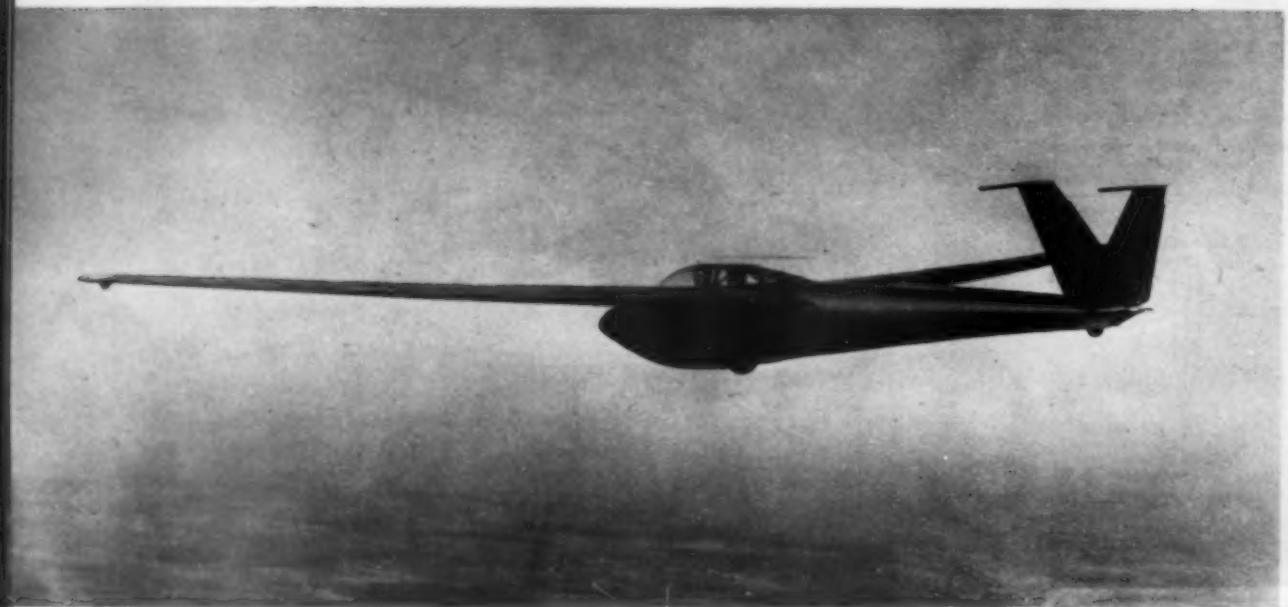
A MOST unfortunate blow to British sailplane development, as well as a tragic injury to an extremely well-liked pilot, occurred with the accident to Elliotts' Olympia IV while being flown by Bill Ivans of the U.S.A. on the last day of this year's World Gliding Championships in France. The laminar-flow wing of this machine had been considerably modified since the 1955 national competitions, and the ailerons had been enlarged.

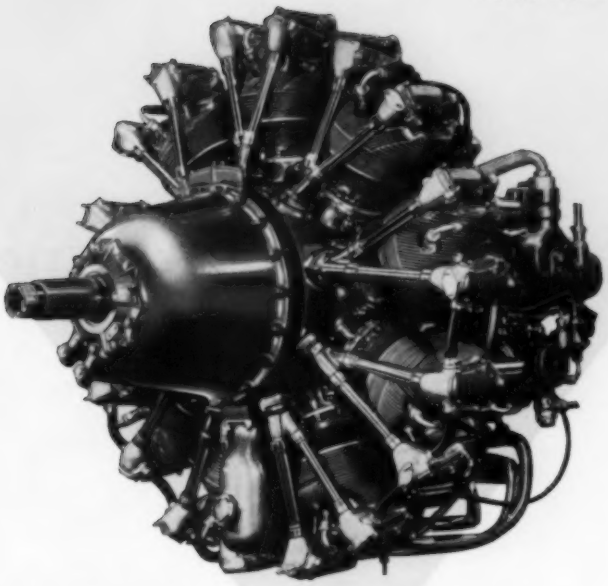
A second example of this type is to be built, incorporating the same wing, a modified canopy and an entirely re-designed tail unit. This aircraft will have an extended cockpit with improved view. Meanwhile, the original Olympia II is still considered by the company to be the finest all-round high-performance club machine, and indeed extremely large numbers of this type remain in service with clubs and private syndicates.

A new type which was taken over by Elliotts during the last year is the K-1 two-seater. Following an exhaustive series of flight tests the wing of this sailplane has now been considerably modified—the tip section having been changed and slight washout introduced—with a consequent improvement in stalling characteristics. The possibility of an eventual design which would be a combination of the Olympia IV and the K-1 has been under investigation by the company.

The latest Newbury product is the new Eon Baby. Now undergoing flight testing at the Lasham Gliding Centre, this intermediate trainer is claimed to have better directional stability than the former Baby. It incorporates a new tailplane and mass-balanced elevators.

K-1 two-seater.





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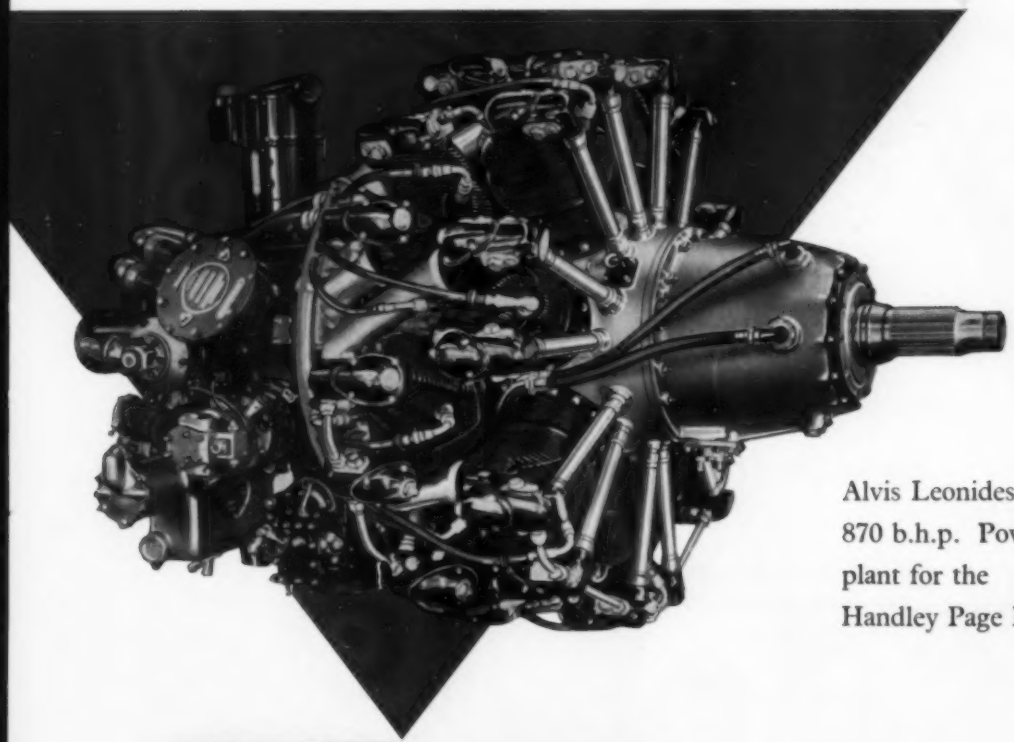
plant for the Twin
Pioneer and the
Prince V.

Complementary Engines



Alvis Leonides Major
870 b.h.p. Power
plant for the
Handley Page Herald.

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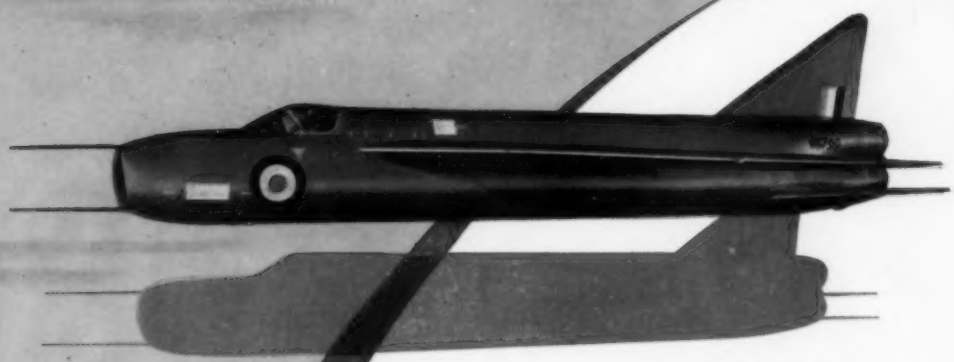

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English Electric P.1 aircraft have already logged some hundreds of flying hours—much of it at speeds above Mach 1. Twenty pre-production aircraft have been ordered, and construction is well under way.

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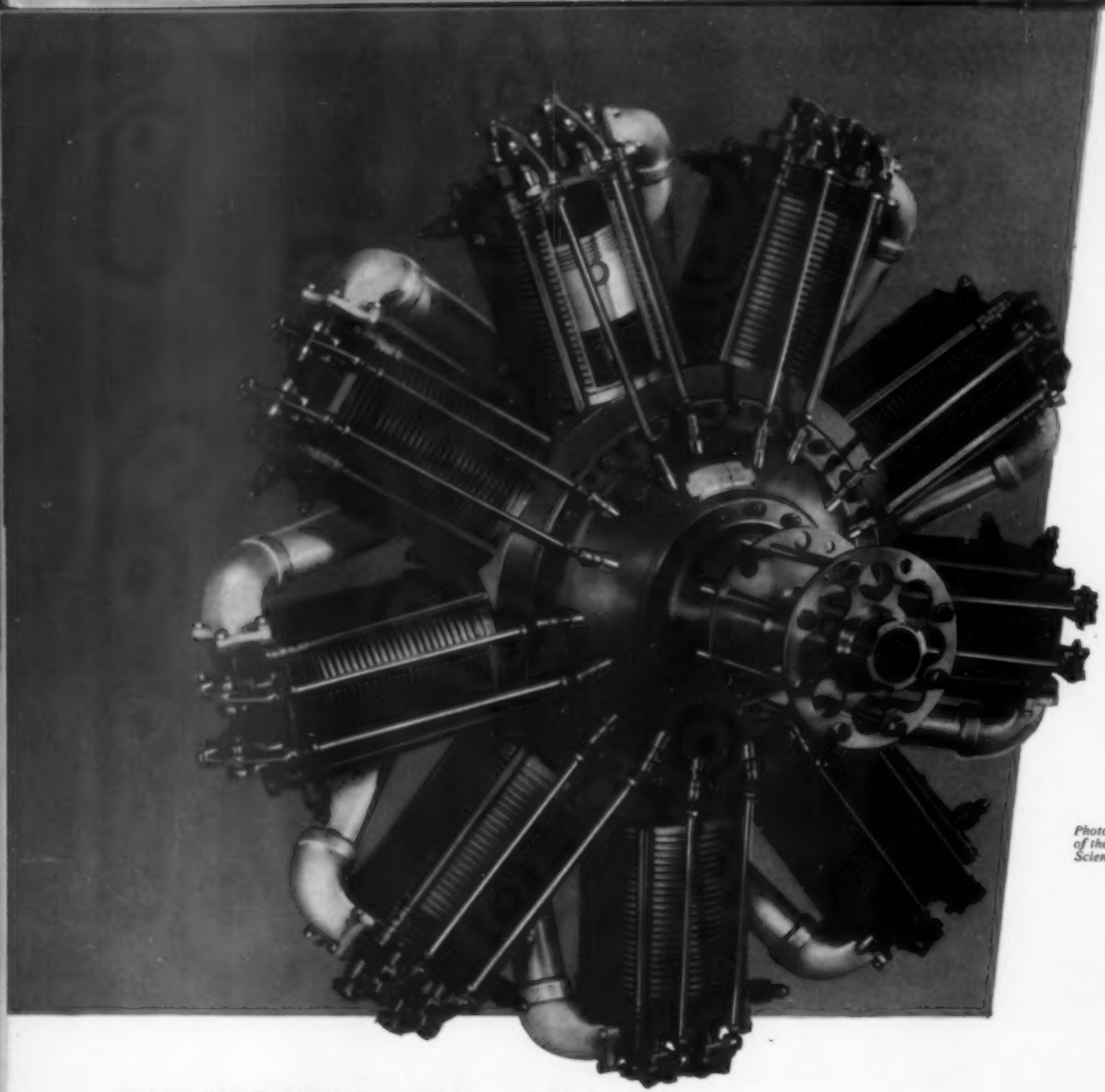

Photograph by courtesy of the Director of the Science Museum.

ON OCTOBER 27th, 1918 ...

...a lone Sopwith Snipe piloted by Major W. G. Barker of 201 Squadron was winging its way along the Western Front in World War 1. Suddenly, he ran into a formation of enemy Fokkers. Dogfight after dogfight ensued. Although wounded and hopelessly outnumbered, Major Barker relentlessly pressed home the attack, shooting down plane after plane. By some miracle of fortune he escaped with his life and returned to base safely. For his conspicuous gallantry and heroism in the face of great odds he was awarded the V.C.

The Sopwith Snipe's engine was the last representative of a long line of rotary development. It was built by Bentley, of car fame, and gave 230 b.h.p. at 1,300 r.p.m. with a bore and stroke of 140 mm. and 180 mm. Fuel and oil consumption were prohibitively high at 21 gals/hr. and 18 pints/hr! In place of the old cast-iron pistons aluminium alloys were now being used and for the cylinder barrels too the Bentley used cast aluminium shrunk on to steel liners. But this successful British rotary came too late. The B.R.2 was fighting for an already lost cause. The golden age of the rotary was rapidly drawing to a close.

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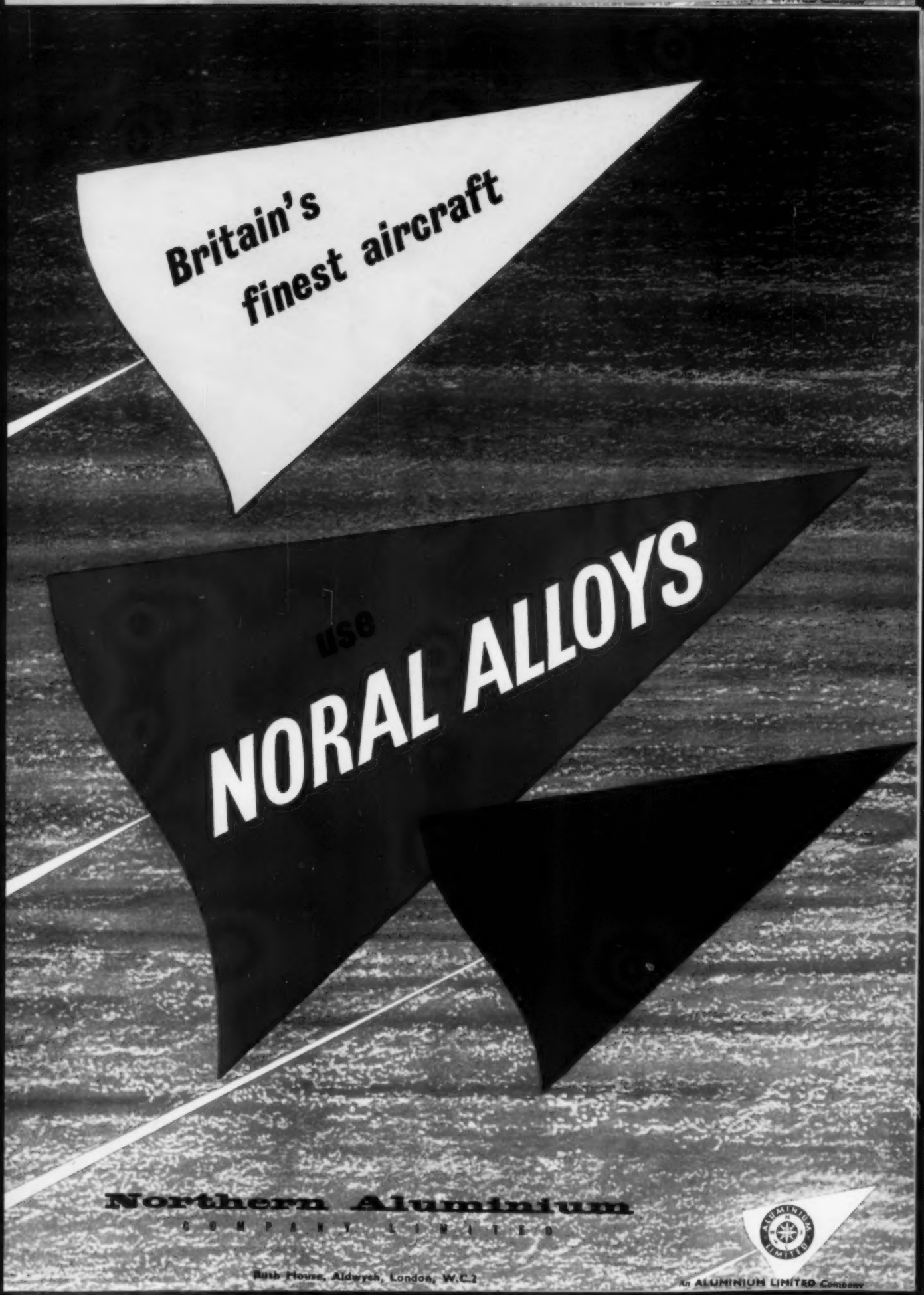
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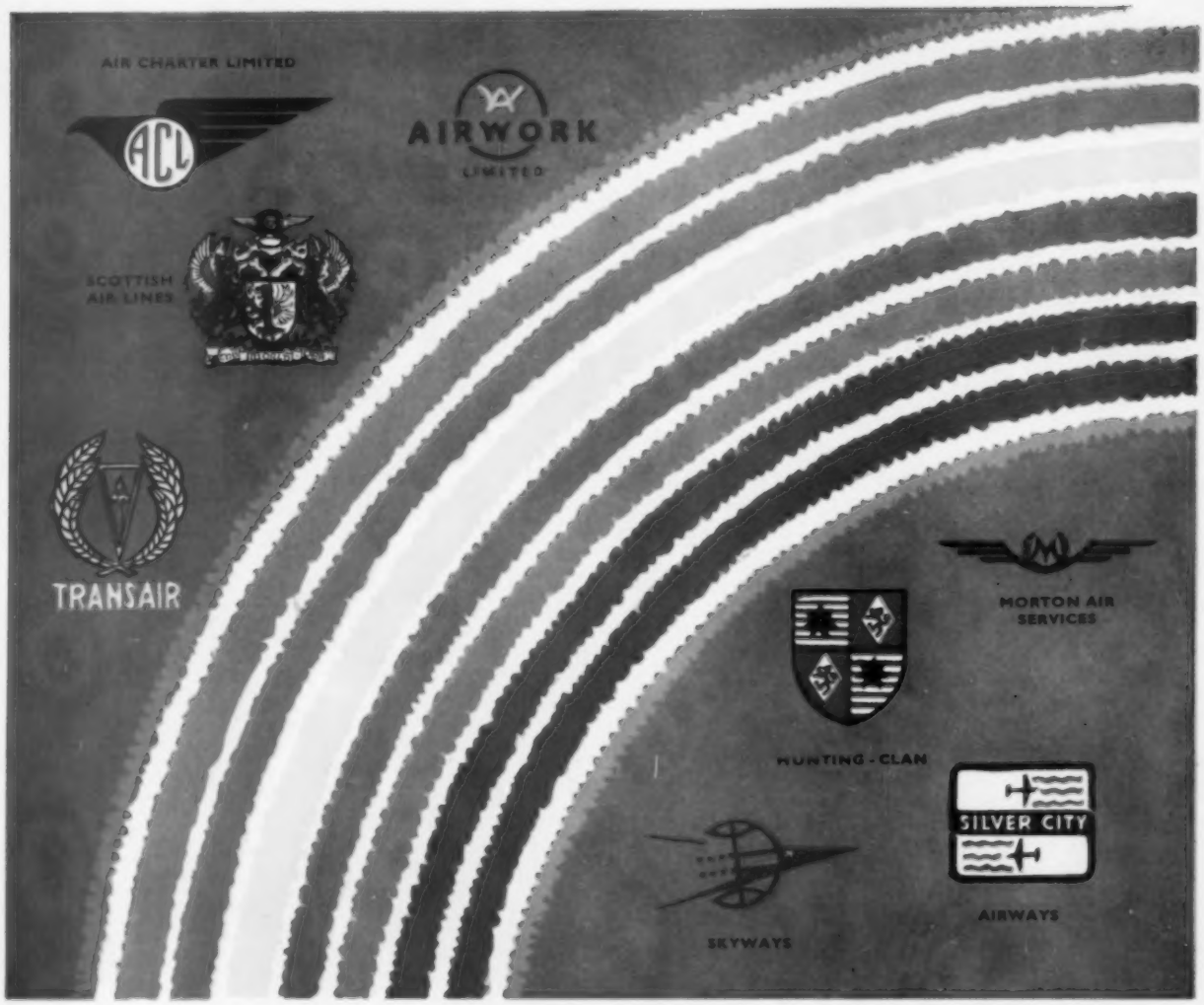

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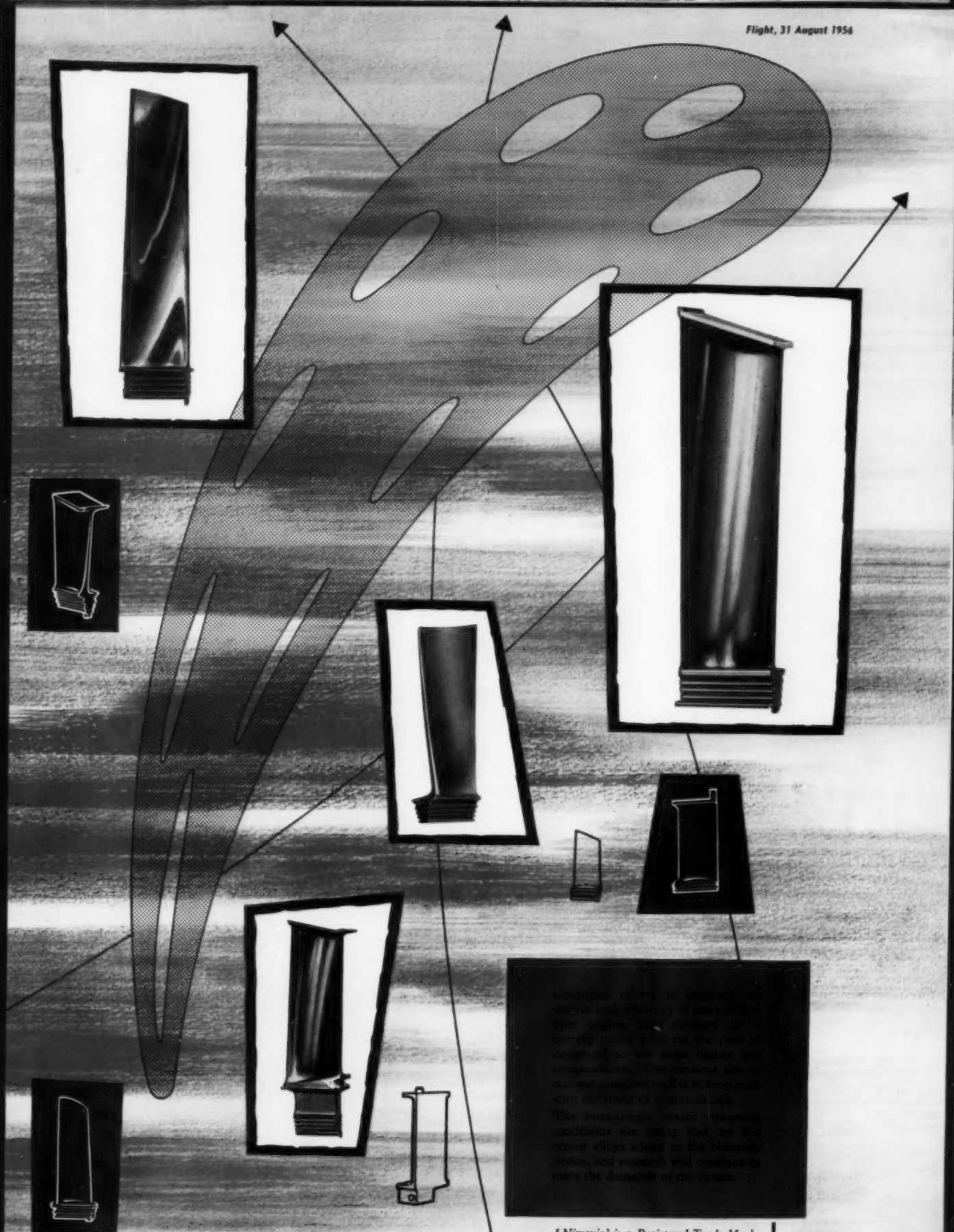

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Slingsby Skylark 3.

SLINGSBY SAILPLANES, LTD.

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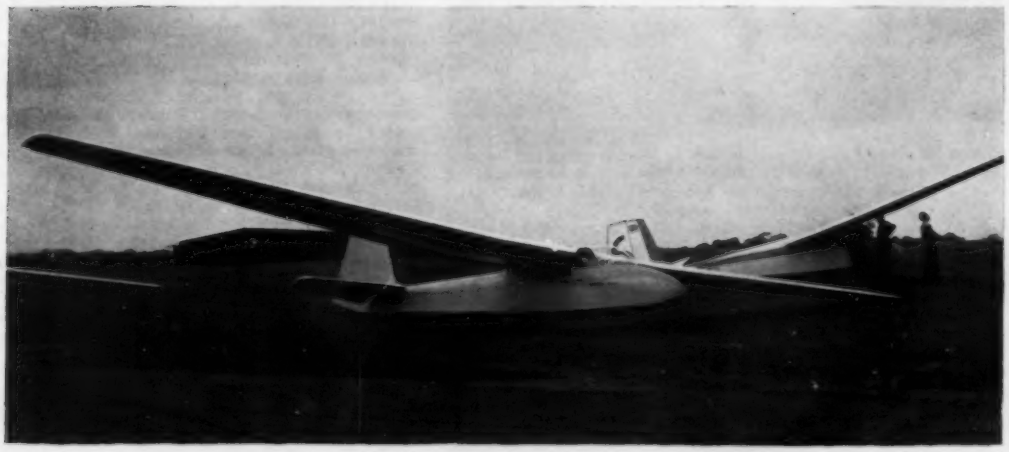
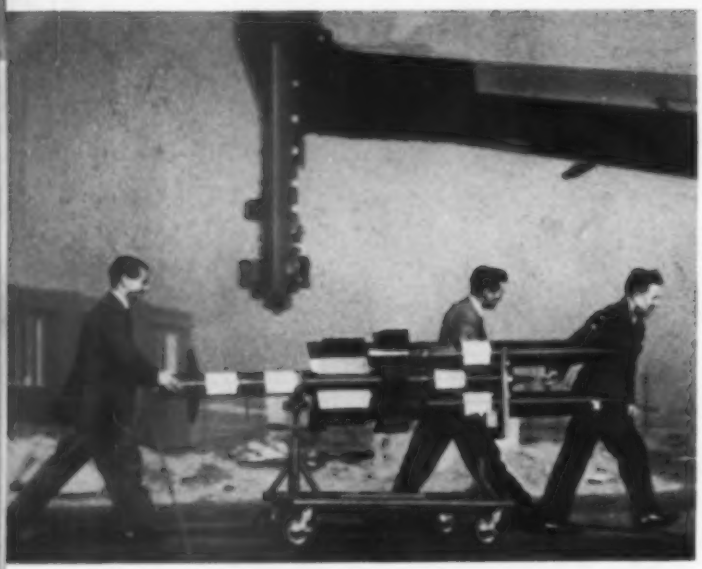
BY WINNING the two-seater section of the World Gliding Championships this year in the second prototype of the Slingsby T.42 Eagle, Nick Goodhart and Frank Foster focused international attention on a machine which not only was not designed for contest flying (and indeed had been referred to as the "flying sardine-box" at St. Yan) but which had exceeded in performance some of the most elaborate and expensive sailplanes in world gliding today. The T.42, of 17.8 metres span, was designed to meet a new need in gliding training—that for an advanced training aircraft capable of good cross-country performance; a sailplane that would help to bridge the gap between the "C" and "Silver C" certificates where, in the past, so much has been left to individual hit-or-miss soaring in solo machines. Production of the T.42 for the British and export markets is to begin in January.

In the single-seater field, Slingsby's latest is the Skylark 3, six of which were entered in the world championships. Two Skys and three Skylark 3s were among the top eleven in the final single-seater placings. The prototype of the Skylark 3 made its first public appearance at last year's national contests at Lasham, since when the type has undergone minor modifications. With a gliding ratio of 32, the 18-metre Skylark 3 has already begun to follow the example of its older brothers the Sky and Skylark 2 in its appeal to clubs, schools and individuals, abroad as well as in this country. The Slingsby company's export business in types such as these, in addition to the ubiquitous T.21b side-by-side trainer, has for some years been running at a high level and, with the Skylark 3 and T.42 now entering the field, the Kirbymoorside factory should continue to be extremely busy. Present production is concentrated on Skylark 2s, Skylark 3s and T.21bs, with approximately 40 Skylarks and 250 T.21s having been constructed to date.

Slingsby T.42 Eagle.

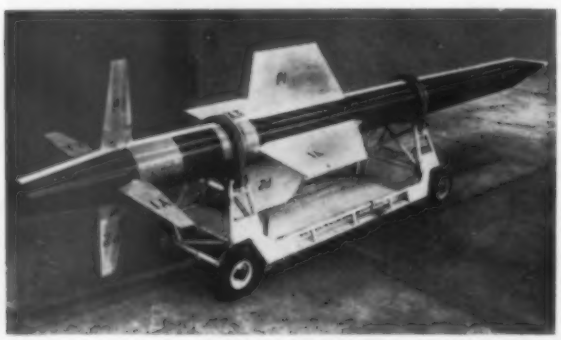


GUIDED MISSILES



The first British guided missile to be supplied to the R.A.F., the Fairey Fireflash, being wheeled out to its carrier aircraft for firing tests.

Fireflash mounted under the wing-tip of a Meteor N.F.11 in flight.



(Above) A general-purpose vehicle built by Short Brothers and Harland for guided weapons research. (Below) A test vehicle being launched from one of the sites at the Aberporth range in Wales.

THE British missile scene is still obscured by security regulations, but with one notable exception. On February 28 information was officially released concerning the Fairey Fireflash, a guided air-to-air weapon. The Fireflash, it was stated, was the first missile which, designed, developed and manufactured by a British company, had successfully destroyed a radio-controlled target aircraft. Photographs taken from a ciné film and subsequently released showed numerous details of this weapon and of its progress from the wing-tip launching pylon on a Meteor N.F.11 to its detonation close to the port wing-tip of the Firefly 8 target drone.

Following persistent and unfounded rumours that Fireflash could not be carried by the Hunter, official statements were issued to the effect that this weapon was (in February) being fitted to a Hunter and that the combination would shortly be available for trials. A Hunter had in fact flown extensively with two exact replicas of the missile and had exceeded Mach 1 with this load. The Hawker Siddeley Group also stated officially on the same day that the Javelin had been designed from the outset to accommodate missiles [though of a later pattern] and that the aircraft would be able to fulfil the missile-carrying function in every way.

Meanwhile Fireflashes are being produced on a limited scale for Service trials. A Swift, and a Hunter, each modified to carry Fireflashes, are to appear at the S.B.A.C. show next week.

From the small size of the Fireflash in comparison with a number of test vehicles which have from time to time been publicly exhibited, particularly at the Farnborough Jubilee celebration last year, it may be supposed that the Fireflash is a relatively simple weapon and it has been surmised that it is a beam rider whose only propulsive effort is derived from its two large boosters. That semi-active guidance systems of various types are being most actively developed was shown at the Farnborough Jubilee by exhibits such as a command link guidance system for a Component Test Vehicle 1, a quartz crystal-stabilized centimetric oscillator, curved followers, a spectral density analyzer, beam riding equipment and conical scan and static split aerial systems. Micro-wave research was demonstrated by radio-Doppler effect exhibits, measurement of dielectric properties, micro-wave aerials and friction-controlled gyroscopes. It is noteworthy, however, that none of the vehicles and equipment then shown referred to anything more than beam riding and semi-active (homing on radar reflections) interception techniques. Active systems are obviously not being ignored and many possible methods of achieving them exist. One of them was referred to in an unconfirmed report originating in America to the effect that a guided weapon being developed by the de Havilland Propeller Company was based on infra-red homing devices.

Many companies are engaged in developing complete missiles for air-to-air, ground-to-air and sea-to-air roles, and many more are producing components for them. Among these are Vickers Armstrongs, English Electric, Napier and Marconi, Armstrong Whitworth, Short Brothers and Harland, and Bristol Aircraft. Shorts have publicly exhibited a general-purpose vehicle with a radar homing head jointly prepared by R.A.E. and Elliott Brothers (London), Ltd., An R.T.V.1 was made by Marston Excelsior and Armstrong Whitworth; and G.Q., Ltd., have shown pictures of their triple drag 'chutes being deployed to recover a missile. English Electric, de Havilland and Faireys have all shown missile test models of various forms. Two important developments in the missile-propulsion field were recently revealed by Bristol and Napier—the Bristol Thor and Napier ramjet engines. Many examples of both units have been fired in Ram Jet Test Vehicles and extremely high speeds and rates of climb have been achieved on the very high thrust available. Further development is in hand. Principal applications are thought to be in ground-to-air weapons. Missiles based on the above projects might enter service during the next few years. From the dimensions of test vehicles it might be judged that an air-to-air missile will in future measure up to 25ft in length and weigh in the region of 2,000 lb.

English Electric are now reported to be in production with a land-based anti-aircraft missile and to have been working on at least one other project, including a "celestial" ballistic missile having a very high trajectory and a range of 1,000 miles or more and possibly using a form of star tracking. Napier might provide the rocket motor and Marconi the guidance system.

British Aero Engines

1956

IT is no exaggeration to claim that Britain can offer the world a wider range of aircraft powerplants than can any other country. Large, medium and small turbojets; military and commercial by-pass engines; fully developed commercial turboprops; all types of piston engine; unique installations producing compressed air or hot gas for helicopter tip-drive and flap blowing; advanced rocket motors; ramjets, pulsejets . . . the list is indeed an impressive one, the like of which has not been seen before. It is, in fact, widely held that the British industry's engines more than make up for any deficiencies which there may be in airframes. Engines are, of course, particularly good export items, since their manufacturers receive spares orders worth perhaps one-fifth of the cost of a complete engine each year that a unit is in service. Already, for example, Rolls-Royce estimate that the whole of their great works at Derby could, by 1961, be engaged solely in the manufacture of spares for Dart turboprops. Such considerations are likely to become increasingly important in view of Britain's prospects of becoming the world's major exporter of advanced aero engines. Already we enjoy such a position in the supply of engines for foreign-designed aircraft, for America beats us only by virtue of her massive business in selling American-powered airframes. And engines represent a business to be reckoned with. It is not generally appreciated, for instance, that the powerplants for the forthcoming long-range jet transports will each cost rather more than did a typical fully equipped four-engined bomber of World War 2. In the following pages are described all the British engines currently in production, or under development, of which details may be published. The picture is an encouraging one, although certain promising programmes have suffered from the Chancellor's restrictions on expenditure. One welcome aspect of the picture is a slight drawing-aside of the curtain which screens ramjet development.

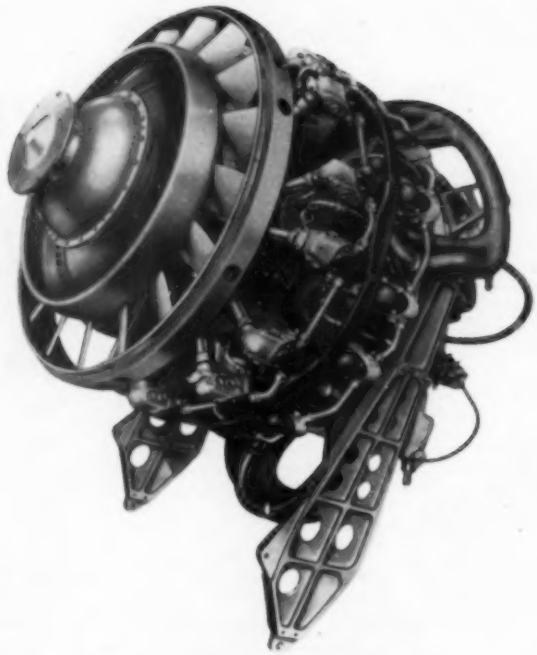
ALVIS, LTD.

Coventry
Telephone: Coventry 5501

Leonides Major. The past twelve months have seen this neat two-row radial piston engine progress from being a little-tried experimental unit to the stage at which it is being type-tested for arduous duty in various roles. Its importance cannot be over-stated, since not only does the whole programme of the Handley Page Herald hinge upon it but it is also scheduled for important applications in the rotary-wing sphere.

As a fixed-wing powerplant it fits a slim low-drag cowling with petal panels giving excellent accessibility. Such installations were first flown in March 1955 in the H.P.R.5 test bed, and have now logged considerably more than one thousand hours in the air—principally in the Herald itself. Special-category approval for the Herald's Major 701 and 701/1 was granted early this year and tropical trials with this aircraft are imminent. For the Whirlwind helicopter a special direct-drive, fan-cooled, left-hand-rotation unit has been evolved, with the form shown in the photograph. A generally similar unit, with vertical crankshaft, has been prepared for the later Bristol twin-rotor helicopters.

Leonides. Approximately a thousand of these nine-cylinder engines have now come off the assembly line at Coventry. Roughly half have been absorbed by the Provost trainer programme and of the remainder a high proportion have been helicopter units which are now at work in all parts of the world. No more arduous applications for aero engines can be found than these, yet the reliability and smoothness of the Leonides have become a by-word. Recent applications for Series 2 Leonides include the Twin Pioneer and President light transports, in both of which the engine is matched to a three-blade de Havilland airscrew.



Alvis Leonides Major A.L.E.M.1-2. Helicopter engine. Two-row 14-cylinder piston engine mounted at 35 deg (in S-55) with supercharger and direct drive with cooling fan. Overall diameter, 38.9in (basic engine); length as shown, about 55in; bore, 4.8in; stroke, 4.41in; swept volume, 1,118 cu in; dry weight, approximately 1,050 lb; maximum (5-min) rating, 750 h.p. at s-l. at 2,900 r.p.m. with 6 lb/sq in boost.

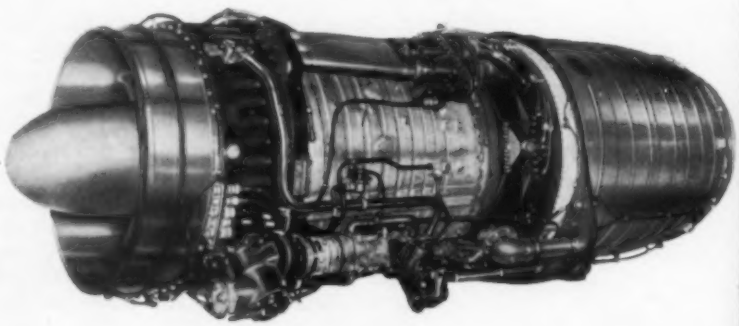
ARMSTRONG SIDDELEY MOTORS, LTD.

Parkside, Coventry
Telephone: Coventry 62666

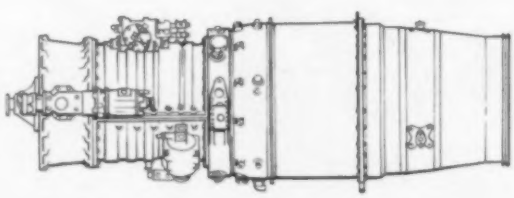
Sapphire. Many hundreds of these excellent single-shaft turbojets have now been delivered by Armstrong Siddeley (Brockworth), Ltd., whose Gloucestershire factory is one of England's major engine plants. Most of the engines so far delivered have been for Hunters, and have generally been rated at from 8,000 to 8,500 lb thrust, the latter rating being characteristic of the Sapphire 12 with cast turbine blading.

The photograph shows the first production variant of a new family of Sapphires which are now becoming predominant over their less-powerful predecessors. Although still subject to stringent security considerations, these new engines clearly have a higher pressure ratio and a greater mass flow. They embody a tapered compressor casing, an advanced form of hot-air de-icing, a fuel/oil heat exchanger and a reduced number of burners. Considerable development has also taken place upon afterburning Sapphires, the reheat jet-pipe employing vaporizing fuel burners and utilizing components supplied by Dowty Fuel Systems, Ltd.

Viper. Originally this small turbojet was designed as a short-life unit for pilotless targets, and the first versions are rated at 1,640 lb thrust for the low weight of 365 lb. A feature of these early Vipers is that they can be started either by an air-jet directed on to the turbine or by a direct mechanical connection to an external source of shaft power. In spite of their characteristics and low utilization of advanced materials, these early engines showed themselves capable of achieving an excellent life. Accordingly, the ASV.5 was evolved as a completely



Armstrong Siddeley Sapphire ASSa.7. Single-shaft turbojet. Multi-stage compressor, annular combustion chamber and multi-stage turbine. Overall diameter, 37.4in; length as shown, 132in; dry weight (including anti-icing, turbo-starter, high-energy igniters and oil tank), 3,075 lb; mass flow, and pressure ratio, restricted; maximum thrust, 10,500 lb at 8,600 r.p.m. with s.f.c. of 0.885.



Armstrong Siddeley Viper ASV.10. Trainer turbojet. Seven-stage compressor, annular vaporizing combustion chamber and single-stage turbine. Overall diameter, 28in (basic diameter, 23.2in); overall length, about 70in; mass flow, 42 lb/sec; pressure ratio, approximately 4:1; dry weight, 570 lb; maximum thrust, 2,000 lb at 13,800 r.p.m. with s.f.c. of 1.01.

Clear round. Already this year the Short Seamew has flown some 5,000 miles on demonstration flights to Italy, Germany and Yugoslavia. This tough submarine hunter from Belfast has stood up well to the hazards of her European tours—hazards which included snow, ice, bad weather, rough landing grounds and handling by strange pilots. Critical eyes have watched her proving the validity of the three basic claims made for her.

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Rugged *"It took some time to clear the aircraft of snow and ice," says our pilot's report from Rome. "After that the Seamew started up and flew off like the sturdy little aircraft she is." It was real Seamew weather on the Italy and Yugoslavia trips—bitter cold, low cloud, snow and rain.*

Efficient *No special crew for the Seamew, just one engineer flying with the pilot. In the modest words of the official report: Both the airframe and the engine (Armstrong Siddeley Single Mamba) proved trouble-free.*

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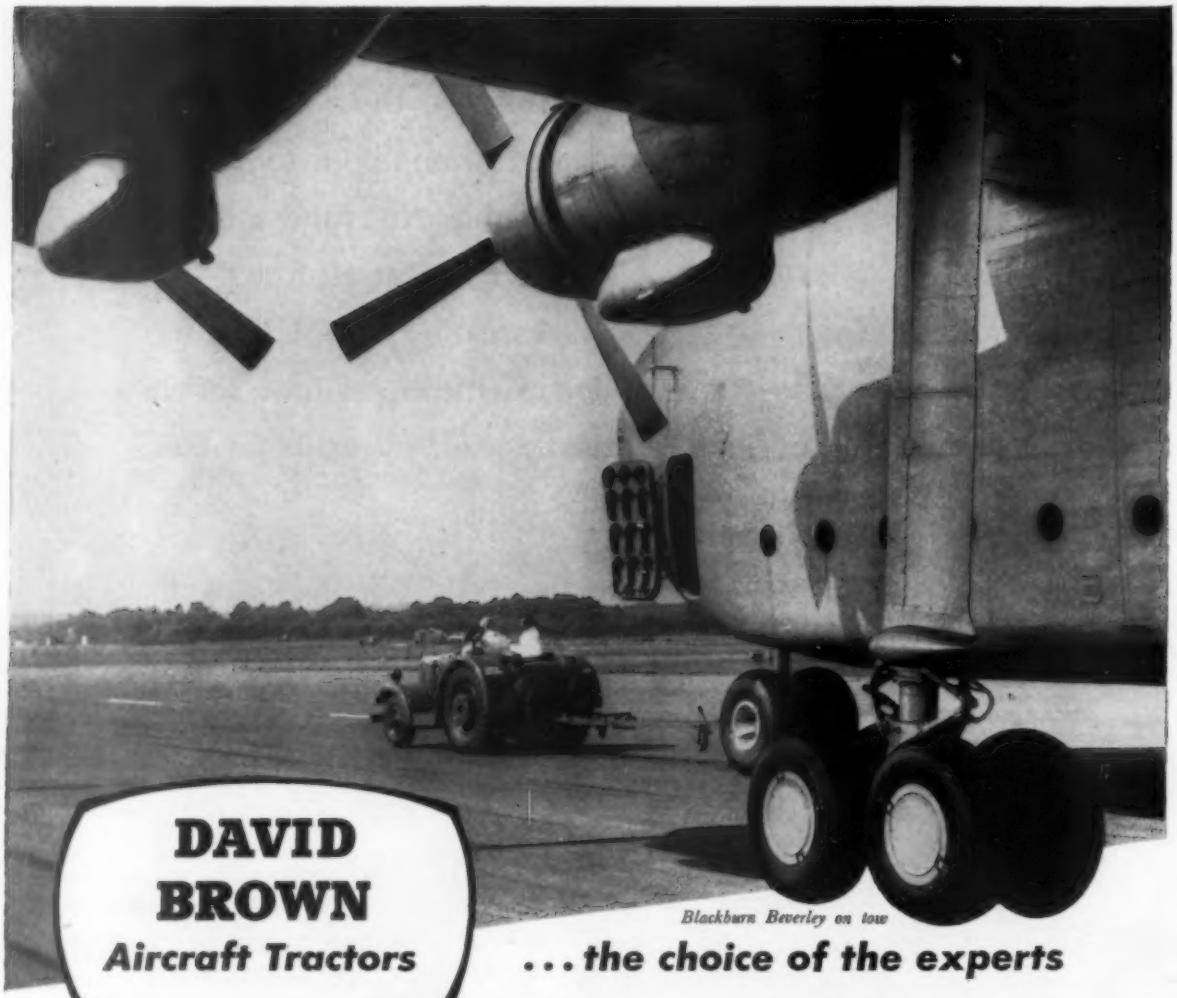

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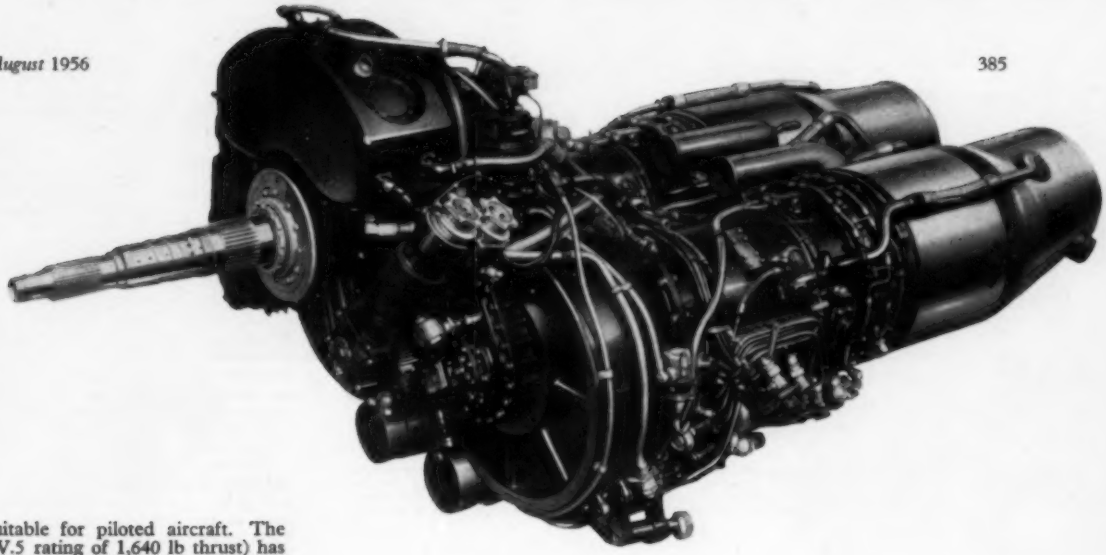
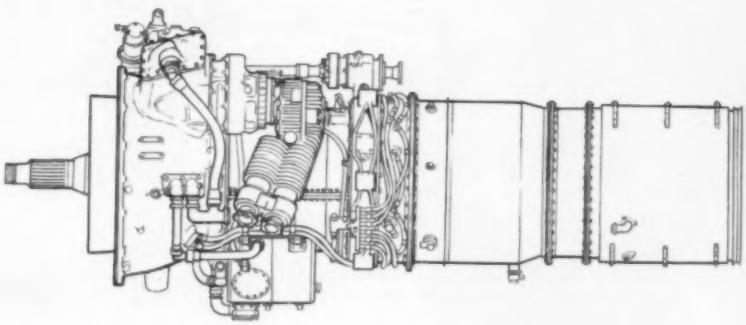


Armstrong Siddeley Double Mamba ASMD.3. Double turboprop. Two mechanically independent power sections each driving one unit of twin-coaxial airscrews; each power section is that of a Mamba ASM.5, with ten-stage compressor, annular combustion chamber and three-stage turbine. Overall width, 52.8in; height, 44.25in; length, 98.7in; dry weight, 2,200 lb; mass flow (total), 37 lb/sec; pressure ratio, 5.35:1; maximum rating, 3,035 e.h.p. (2,740 s.h.p.+770 lb) at 15,000 r.p.m. with s.f.c. of 0.71. This engine is cleared to run on ship's diesel fuel.

new design suitable for piloted aircraft. The Viper 101 (ASV.5 rating of 1,640 lb thrust) has been used in the early Jet Provosts. The ASV.7 is an afterburning development intended for fighters, and the ASV.8 is the current training engine rated at 1,750 lb thrust at 13,800 r.p.m., 400 r.p.m. higher than originally.

These basic Vipers, with a mass flow of 32 lb/sec, are now in wide use and the basic design has been developed under licence by Marcel Dassault in France, both with and without afterburner and rated dry at 2,975 lb thrust. The engine depicted in the drawing has a considerably increased mass flow and embodies several major refinements in construction. The ASV.11 is an experimental development running at higher top temperature and rated at 2,460 lb thrust.

Mamba. After a decade of development the unit shown in the diagram is a most reliable engine giving a very useful performance from a small bulk. As its principal application is Naval it has been so designed that it maintains constant r.p.m. under normal flight conditions so that acceleration from minimum to maximum power is exceedingly rapid. Furthermore, it is cleared to run on ship's diesel fuel should this be necessary. Points of note include a cartridge starter, a vapourizing annular combustion chamber, and, compared with earlier Mambas, additional stages on both compressor and turbine.

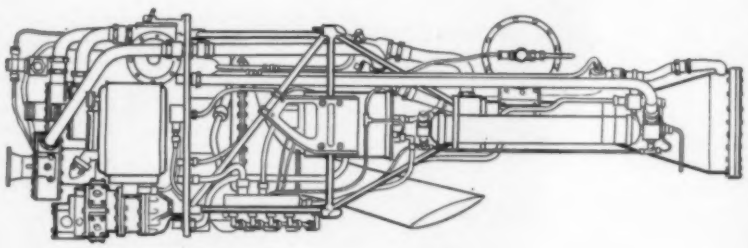


Armstrong Siddeley Mamba ASM.6. Single-shaft turboprop. Eleven-stage compressor, annular combustion chamber and three-stage turbine. Overall diameter, 33in (basic diameter, 29in); length as shown, 90.2in; dry weight, 951 lb; mass flow, over 20 lb/sec; pressure ratio, about 6:1; maximum rating, 1,770 e.h.p. (1,650 s.h.p.+320 lb) at 15,000 r.p.m. with s.f.c. below 0.695.

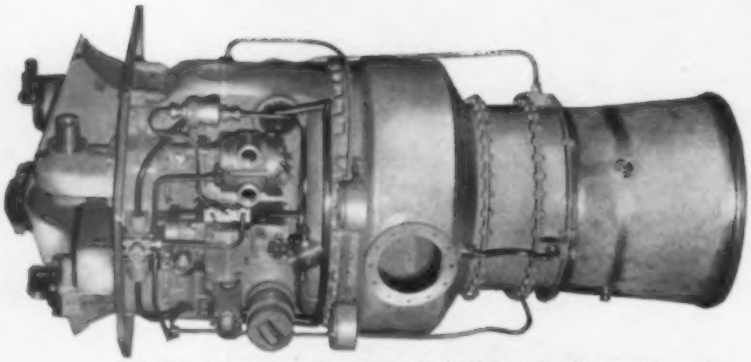
Double Mamba. Standard powerplant of the Gannet, this unusual engine comprises two mechanically independent Mamba power sections, each coupled to one half of a double coaxial airscrew. In cruising flight either half of the engine can be shut down. The ASMD.3 shown in the photograph has now replaced the ASMD.1 in production, and it is expected that more powerful Double Mambas will become available in the future. The original engine is now very widely used by the Royal Navy and the Royal Australian Navy and its behaviour has been exemplary.

Screamer. Culminating ten years of development of rocket motors using liquid oxygen and hydrocarbon fuel, the Screamer is a well-engineered and highly developed motor, in the development of which some 36 hr actual running time was logged in the course of some 1,350 firings.

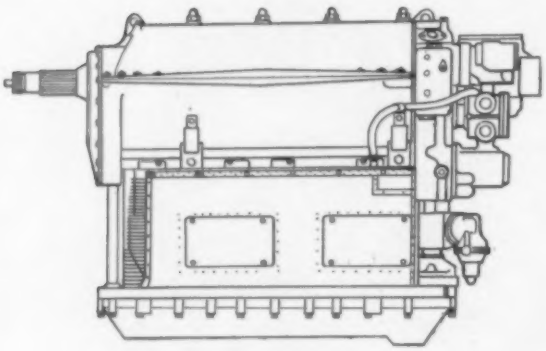
The propellants are fed by centrifugal pumps driven by a single-stage, side-injection, impulse turbine turning at 20,000 r.p.m. and delivering some 350 s.h.p. The turbine is energized by a secondary flow of the propellants mixed in a gas generator and exhausting independently. A throatless chamber is employed, regeneratively cooled by water which is finally injected into the chamber itself to provide film cooling. The thrust can be varied between 2,000 and 8,000 lb (at sea level) by a single throttle lever.



Armstrong Siddeley Screamer. Single-chamber, pump-fed rocket motor running on a mixture of: liquid oxygen, 60 per cent; wide-cut petrol, 23 per cent; and water, 17 per cent. Overall installational diameter of unit, 27in; overall length, 78.5in; dry weight, fully equipped, 470 lb; combustion chamber mass flow, pressure and temperature at full thrust, 36.84 lb/sec, 600 lb/sq in and 3,200 deg C, respectively; thrust, 8,000 lb at full throttle at sea level, rising to 9,500 lb at 40,000ft.



Palouste, air-compressing gas turbine. Single-sided centrifugal compressor, annular combustion chamber with rotating fuel-injection nozzles, and single-stage turbine. Maximum diameter, 17.7in; height, about 18in; length, basic engine, 28.62in; dry weight, 178 lb; delivery 2.725 lb/sec air at 41.55 lb/sq in gauge, with fuel consumption of 310 lb/hr.



Cirrus Bombardier 203, inverted four-in-line, air-cooled and with direct fuel injection. Bore, 4.8in; stroke, 5.5in; swept volume, 389.12 cu in (6.524 litres); width, 17.2in; height, 31.1in; length, 46.8in; dry weight, 350 lb; maximum power, 175-200 b.h.p. at 2,600 r.p.m.

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Gas Turbines. It is now four years since Blackburn began to develop a rationalized range of units based on the small gas turbines developed in France by the Société Turboméca. All these engines have a single-sided centrifugal compressor and an unusual combustion system comprising an annular, collander-like flame tube into which fuel is sprayed through radial drillings in the rotating tubular drive-shaft which couples the turbine and compressor. An unusual feature common to all is a bifurcated intake duct extending forward from the eye of the compressor to the extreme front of the engine where a large wheel case provides up to 12 drive faces for a variety of accessories.

The basic unit is the Palas turbojet. At present the only British application is the Somers-Kendall S.K.1 light racer, although other projects such as the Miles Student would also employ such an engine. By fitting a combustion system and turbine of reduced dimensions and then bleeding off the excess air delivered by the compressor, one can turn the Palas into the Palouste air-compressor unit. This engine is in production for various ground applications (including aircraft-starting trollies, as illustrated on page 404) and is also used in the Fairey Ultra-Light helicopter where it supplies compressed air to the rotor jets. By adding a second turbine stage to the Palas it is possible to obtain excess shaft power which can then be extracted at the front of the engine through a conventional reduction gearbox, thus converting the unit into the Artouste. The Artouste 610 has an airborne application in the auxiliary generating plant for a British medium bomber and can also, of course, act as a turboprop engine in its own right. In the Turmo the added turbine stage is mechanically independent and drives a gearbox mounted at the rear of the engine, the exhaust gas being taken away through an inclined trunk of rectangular section. The free-turbine principle of the Turmo is particularly useful in helicopter applications, especially since a variety of reduction-gear ratios can be fitted. A derivative is the Coupled Turmo, comprising two Turmo power sections geared to a common output shaft, free wheels being provided to enable either power section to continue the drive independently.

Piston Engines. Limited production is continuing upon the direct-injection Bombardier 203. In the Auster A.O.P.9, standard equipment includes a cartridge starter. On ordinary military M.T. fuel the rated horsepower is 173 but values greater than 200 h.p. can be obtained with proper aviation petrol, and on high-octane fuels it is expected that figures approaching 250 h.p. will eventually be obtainable.

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Olympus. As far as published figures are concerned, this excellently engineered two-spool turbojet has a better thrust/weight ratio than any other large gas turbine. It was in fact one of the first split-compressor gas turbines ever to be built, and when it was first announced four years ago the rated thrust and specific fuel consumption were 9,750 lb and 0.76. Since then the engine has progressed tremendously and the version depicted in the drawing was type tested last November at 12,000 lb dry thrust and is in production at this rating (presumably for the Avro Vulcan).

The engines are exceedingly fully equipped and considerably more advanced in design than their predecessors. Such units have twice gained the world altitude record and still hold this honour at a figure of 65,890ft in a Canberra. Although no official mention has been made of the fact, it has frequently been reported that afterburning units are under development, presumably with a view to applications other than the Vulcan. It is known that co-operation with Solar Aircraft involves the development of afterburners for "large Bristol turbojets" and there have also been frequent references to a system of "Bristol Simplified Reheat" in which fuel is injected into the tailpipe to provide limited augmentation with a fixed-area nozzle. The existence has also been revealed of a later series of Olympus, of which the first rating to be announced is BOl.6. These engines have been unofficially reported to be in the 15,000 lb-thrust class without afterburning. One assumes that the commercial Olympus 511, which is suitable for such aircraft as the largest American jet transports, is in fact a derivative of this new family of engines.

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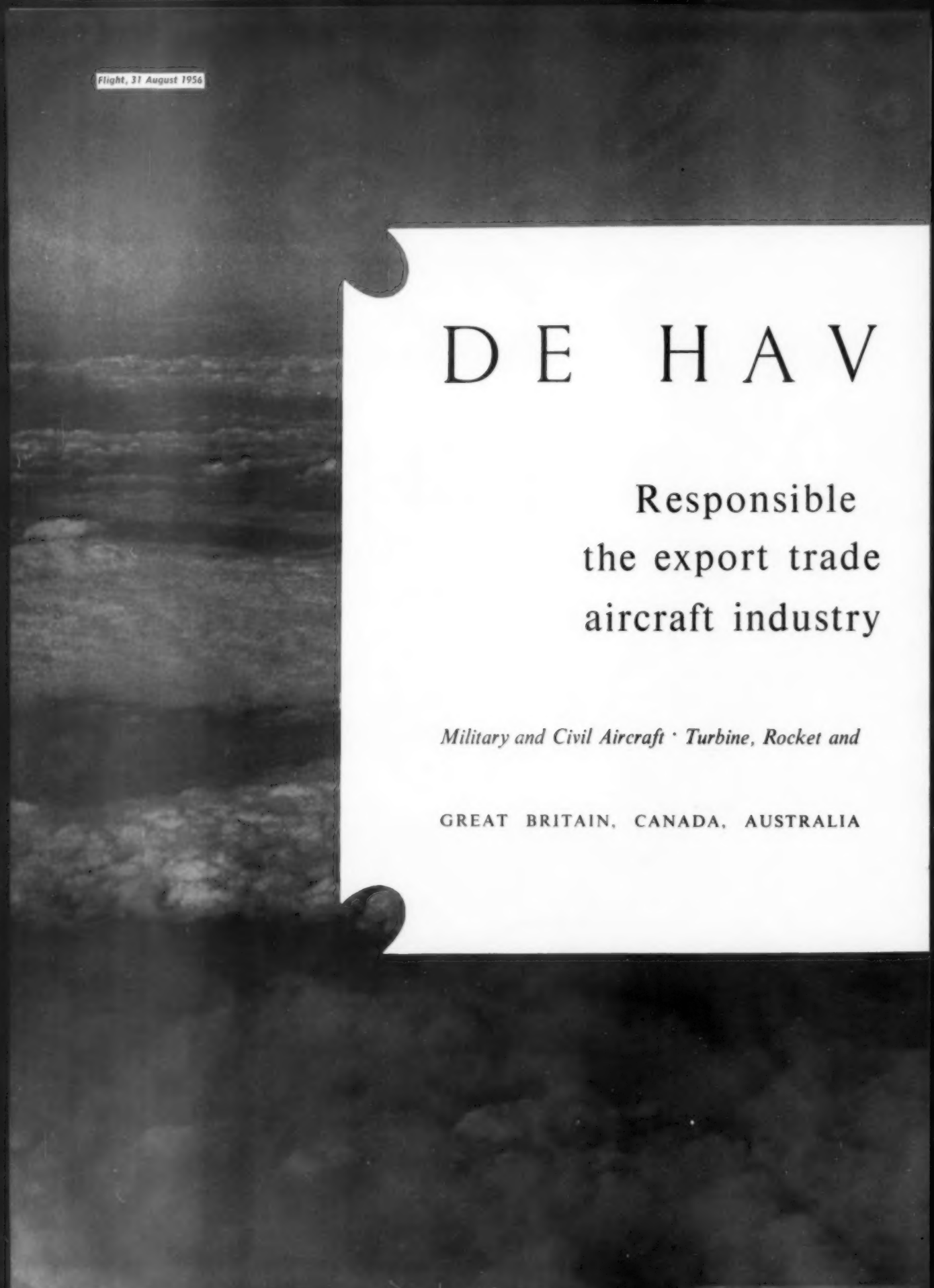

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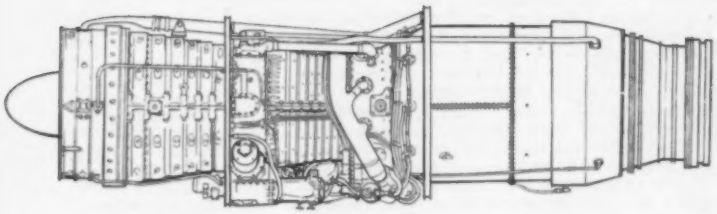
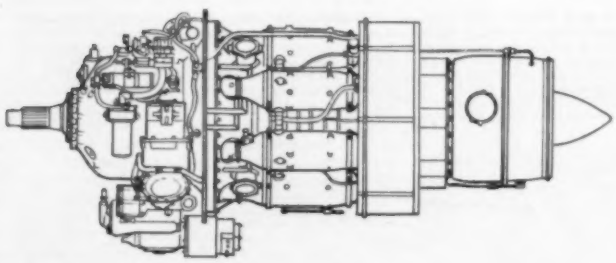


Bristol Olympus 102. Split-compressor turbojet. Multi-stage low-pressure and high-pressure compressors driven by independent turbine stages and annular combustion chamber with ten burners. Diameter, 40in; length, about 125in; dry weight, about 3,700 lb, equipped; mass flow and pressure ratio, restricted (reported to be 165 lb/sec and 10:1 on the earlier Mk 101); maximum thrust, 12,000 lb dry (r.p.m. and s.f.c., restricted, but reported to be 6,500 l-p. and 0.79 on the Mk 101).

Bristol Orpheus (BOr.3 rating). Single-shaft turbojet. Reported to be seven-stage compressor, annular combustion chamber and single-stage turbine. Overall diameter, 32.4in; length as shown (with jet pipe), 150in; dry weight, about 750 lb; mass flow and pressure ratio, restricted; maximum thrust, 4,850 lb, reportedly with s.f.c. of 0.99. An afterburning version of this engine is being developed.



Bristol Proteus 755. Free-turbine turboprop for transports. Compressor has 12 reverse-flow axial stages followed by one centrifugal stage, delivering to eight combustion chambers two stage compressor turbine and two stage power turbine. Overall diameter, 40.1in; length, excluding airscrew shaft and tailcone, 100.6in; dry equipped weight, 2,850 lb; mass flow, 43.8 lb/sec; pressure ratio, 7.2:1; maximum rating, 4,120 e.h.p. (3,650 s.h.p. + 1,220 lb thrust) with s.f.c. of 0.6; cruising at 400 kt at 25,000ft at 98.2 per cent compressor r.p.m. and 9,920 turbine r.p.m. (855 airscrew r.p.m.), 2,890 e.h.p. (2,280 s.h.p. + 398 lb) at s.f.c. of 0.445.

Orpheus. Bristol Aero Engines can be exceedingly proud of the fact that, although the design of this trim, medium-sized turbojet was only begun (as a private venture) in 1953 and prototypes have run for only 19 months, it has already completed over 5,000 hr of development testing, has passed various type tests at steadily increasing ratings and has flown at supersonic speed and at altitudes in excess of 50,000ft. The first full type test was actually completed five months from the first bench run and the latest type-tested rating is already higher than that required by the original applications. Present development running is now going ahead at still higher ratings and there is no reason to doubt that the basic Orpheus will be capable of eventually yielding thrust of the order of 6,000 to 7,000 lb.

Already such progress has been rewarded by selection of the engine for a variety of new or projected types of aircraft, including machines which are the subject of important NATO programmes. At the time of going to press the full list of such applications comprised: Folland Gnat, Fiat G.91, Aerfer Ariete, Dassault Etendard VI, Breguet 1001 Taon, the Yugoslav Ikarus B.12, the Spanish Hispano H.A.300 and the Japanese Fuji FIT-1. Certain of these aircraft have trainer applications and it is reported that a special lightened version of the Orpheus will be available for such duty.

Zeus. Although no engine of this name has ever been officially announced as being under current development at Bristol, reports of the existence of such a unit are appearing at frequent intervals. All speak of it as a high-thrust turbojet reported to be of two-spool design and giving a thrust between 12,000 and 20,000 lb.

Proteus. At the present time this is the world's only example of a fully-developed large commercial turboprop. Although the first Proteus ran nine years ago, the present engines are completely redesigned and are exceptionally fine examples of aircraft-propulsion machinery capable of giving thoroughly reliable service for many years. It has a completely unrestricted C. of A. for passenger carrying and is scheduled to start to earn money on B.O.A.C. routes as the powerplant of the Britannia in October.

An unusual feature is its free-turbine layout, i.e. the compressor and its associated high-pressure turbine is mechanically independent of the power turbine and reduction gear to the airscrew. Standard equipment includes Ultra electric temperature control, hot-air de-icing, provision for compressor bleed for cabin pressurization and for the tapping of turbine gas for airframe de-icing, auto-synchronization, a double-helical reduction gear incorporating a hydraulic torquemeter, and an overspeed decoupler for the power turbine to guard against any failure of the drive to the airscrew.

The latter unit is a de Havilland product with four hollow steel blades and a diameter of 16ft. Total test hours on the earlier Proteus 600 totalled 16,836 on the bench and 2,411 in flight; to this can now be added 22,600 bench hours and 20,283 flight hours on the redesigned 700 series, of which nearly all the flight-time has been in the Britannia. All this development has been aimed specifically at commercial service. A major trouble, only recently encountered, has been extinction of combustion during flight through exceptionally heavy icing conditions, but extensive B.O.A.C. and Bristol testing has now established the cause of the phenomenon. Remedial action has been taken and B.O.A.C. already have a number of engines modified to the appropriate standard.

Present B.O.A.C. Britannia 102s are powered by the Proteus 705, which is rated at a take-off power of 3,480 s.h.p. (3,900 e.h.p.) at compressor r.p.m. of 11,700. This engine exceeds the original requirements of these early-production

Britannias at a temperature well below the maximum figure of 1,115 deg K. All later Britannias have the Proteus 755 for which new figures are quoted in the accompanying data. The existence was also recently revealed of a Marine Proteus, which has applications in various types of high-speed naval craft.

Orion. In the design of this very advanced turboprop, Bristol have set out to match the best reciprocating engines in economy and long life, while establishing an appreciably better level in power/weight ratio. Into it has been built the company's very great experience of large-turboprop design, and it promises to be one of the most useful engines available for driving large, long-range aircraft in the 1960s.

It is a two-spool engine with the low-pressure assembly coupled to the reduction gear, which is a double-helical unit virtually identical with that of the Proteus. The low-pressure compressor is similar to the assembly employed in the Orpheus turbojet apart from the fact that the blading is of steel. The work-split and speed ratio between the two spools has been so chosen that neither compressor tends to surge during normal operation. From the outset a major design-choice has been power-limitation, which restrains the potential sea-level horsepower (of about 8,000) to the figure quoted in the accompanying data. The resulting "supercharged" characteristic allows for the full rated take-off power to be obtained at all heights up to 15,000ft, while the maximum-continuous rating does not begin to fall off until 25,000ft is reached (both these figures assume i.s.a. conditions).

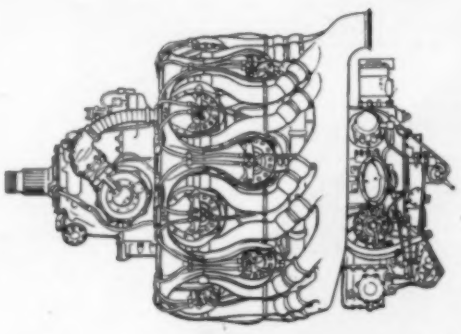
Several prototypes have now run a total of more than 620 hr and one engine has this week been installed in the port outer position on the first prototype Britannia for initial air testing. All Orions are built up as integral powerplants, and bench testing has been conducted exclusively upon complete units; de Havilland are expected to manufacture the production airscrew. The engine is scheduled to become available for service three years hence, and B.O.A.C. have purchased 60 for installation in their long-range Britannia 312s, such conversion being possible during major overhauls. The data and accompanying photograph have not previously been published.

Centaurus. Deliveries are now in full swing of Centaurus 173s for the Blackburn Beverley heavy military transport. There is also a later version of this engine designated 373 (together with a commercial version with the mark number 873) which, by employing direct fuel injection into the cylinder heads, is rated at appreciably higher power and also has other notable advantages. Bristol have a very extensive background of direct-injection work on the Centaurus and the 373 is now at an advanced stage of development. Future design-changes may result in the establishment of still higher ratings.

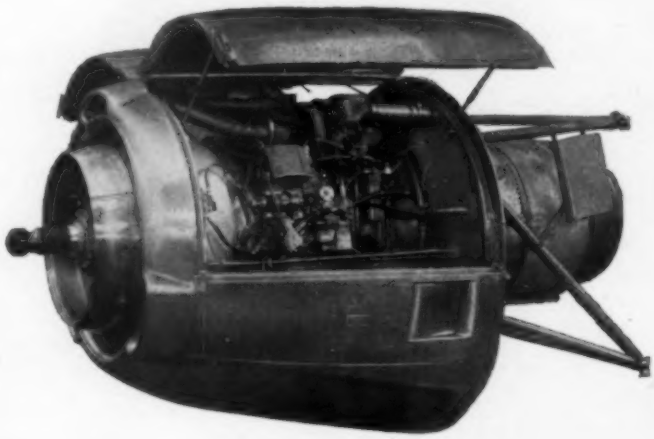
Hercules. Production of this famous 14-cylinder, sleeve-valve piston engine ceased this year after Bristol had delivered more than 70,000. Late-model Hercules, rated at rather more than 2,000 h.p., remain in licence-production by S.N.E.C.M.A. in France.

Ramjets. Only a month ago Bristol were permitted to reveal some of the ramjet work which they have been carrying out under contract to the Ministry of Supply since 1949. Initially they learned about such engines from the Boeing Airplane Company but have for several years been strong enough to work completely unaided. Today they are undoubtedly one of the world leaders in this sphere of propulsion and extremely capable research and development facilities will shortly be in commission.

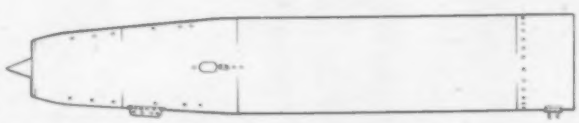
At present the unit illustrated is the only Bristol ramjet to which public reference has been made. In its development over 200 test vehicles have been fired, much of the flight development having been conducted at Woomera. Development on the Thor is considered virtually complete with 100 per cent starting reliability, one of the world's best ramjet fuel systems and several other commendable features which may not be described. Pre-production Bristol ramjet powerplants are now being delivered to meet requirements of various missile programmes and development is going ahead on more advanced units with variable-geometry characteristics.



Bristol Centaurus 373. Piston engine for transports. Two-row, 18-cylinder, sleeve-valve engine with direct injection into the cylinder heads from two C.A.V. nine-cylinder plunger pumps. Diameter, 55.3in (60.5in over cowl seals); length, 74.6in; bore, 5.75in; stroke, 7in; swept volume, 3,270 cu in; dry weight, 3,490 lb; maximum power (wet), 3,220 h.p. at 3,000ft at 2,800 r.p.m. with 13 lb/sq in boost.



Bristol Orion. Split-compressor, power-limited turboprop. Seven-stage low-pressure compressor, five-stage high-pressure compressor, annular combustion chamber with ten flame tubes, single high-pressure turbine stage and three-stage low-pressure turbine coupled to the reduction gear and airscrew. Diameter, 41.8in; overall length, 112.3in; dry weight, including oil tank, oil coolers and suspension units, 3,150 lb; mass flow, 82 lb/sec; pressure ratio, over 10:1; maximum take-off power, maintained up to 15,000ft (i.s.a.), 5,150 e.h.p. (4,400 s.h.p. + 1,950 lb thrust) at 10,000 l-p. r.p.m. with s.f.c. of 0.64; max. continuous rating, maintained up to 25,000ft, 3,900 s.h.p.; cruising rating at 36,000ft at 350 kt, 3,300 e.h.p. with s.f.c. of 0.40.



Bristol Thor. Fixed geometry ramjet with double shock intake, circular section body and convergent-divergent propelling nozzle. Overall diameter approximately 16in; design Mach number, very much greater than that of the fastest aircraft at present flying. (It is calculated that a typical ramjet of Thor size could produce 90,000 thrust horse power at Mach 3 at sea level.)

THE DE HAVILLAND ENGINE CO. LTD.

Leavesden Aerodrome, Herts.
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Gyron. It is just a year since this mighty turbojet was first type-tested and placed on public exhibition. In this time the development of the engine has been most satisfactory.

A particular design choice is a moderate pressure ratio so that a considerable rate of fuel consumption can still be maintained at high supersonic Mach numbers without overheating the hot end of the engine.

Interior details of the Gyron may not yet be published, but it can be stated that it embodies an exceedingly advanced design of compressor which handles an enormous mass flow and a very efficient annular combustion chamber fed from a Lucas fuel system. Production Gyrons may also incorporate a 600-h.p. peroxide turbine starter developed by de Havilland Engines, which seems to fit in well with the company's mixed-power formula for fighters.

Several types of Gyron are now under development and it is expected that they may eventually reach ratings of 20,000 lb thrust, or possibly as high as 27,000 to 30,000 lb with an afterburner. The Short S.A.4 test bed, which last year carried a Gyron in the lower port nacelle, has now been modified to carry a second Gyron in the starboard position.

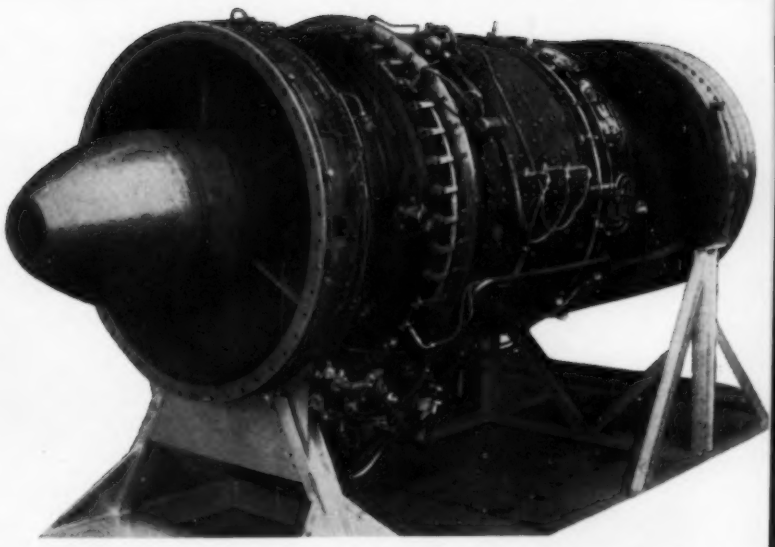
Gyron Junior. Although as we go to press no details whatever of this engine may be published, security restrictions may be eased within the next few days. The name suggests that it is a scaled-down Gyron and this contention is confirmed by several foreign reports, one of which was published in our issue dated May 11 last.

Ghost. This trusty and highly developed turbojet remains in production for all types of Venom fighter/bomber and all-weather fighter. The engine illustrated is likely to be the last variant of the great de Havilland family of centrifugal turbojets. Compared with earlier Ghosts, the 105 is appreciably lighter and it embodies several important design changes which allow it to run at increased temperature and so give higher thrust. In particular, the turbine nozzle guide vanes are hollow and are cooled by compressor bleed air, while the turbine rotor blades are fabricated from Nimonic 95 and have redesigned root serrations which are pinned to the disc. Equipment includes a Lucas fuel system, Ultra/Lucas top-speed control and a Rotax twin-breech turbo-starter.

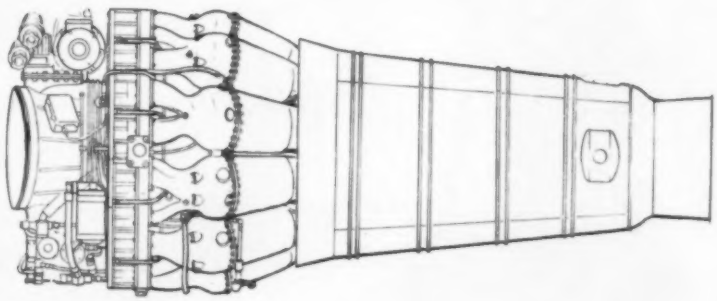
Goblin. Deliveries of Goblin 35s are continuing to meet the requirements of Vampire Trainer production for more than 20 air forces. Some thousands of Goblins are now in service and a typical rating is 3,500 lb thrust.

Piston Engines. Of the renowned series of Gipsy engines, the smaller units are at present being accorded the major proportion of the company's piston-engine development effort. Intensive development is still being carried out on the Major 200 direct-injection unit, which has a slightly larger swept volume than earlier Majors. The Major 200 is a standard powerplant of the Army's Skeeter 6 helicopter and is also offered for fixed-wing applications. It can mount a wide range of accessories and variants are being developed capable of running on ordinary M.T. fuel at a slightly reduced power rating.

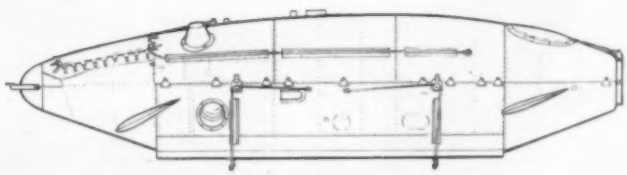
The larger Queen 30 and Queen 70 continue in large-scale production. The former powers the Heron, and is supplied as a bare engine. In contrast, the Queen 70 is used in the Dove and Devon as a complete engine-change unit. The Queen 70 is geared and supercharged and has an injection-type carburettor. It drives a three-blade feathering and reversing airscrew and the Queen 70 Mk 2, the engine at present in production, is rated at 380 h.p.



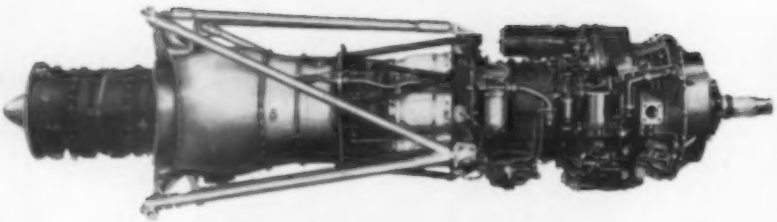
de Havilland Gyron (DGy.1 rating). Single-shaft turbojet. Multi-stage compressor, annular combustion chamber with 17 burners and multi-stage turbine. Overall diameter, 46½in; length as shown, 154in; dry weight, mass flow and pressure ratio, restricted (the mass flow has been reported to approach 300 lb/sec); initial type-test rating, 15,000 lb thrust (r.p.m. and s.f.c., restricted).



de Havilland Ghost 105 (53 Mk 1). All-weather-fighter turbojet. Single-sided centrifugal compressor, ten combustion chambers and single-stage turbine. Overall diameter, 52.7in; length, 129in; dry weight, 2,135 lb fully equipped; mass flow, 88.5 lb/sec; pressure ratio, 4.7:1; maximum thrust, 5,300 lb at 10,350 r.p.m. with s.f.c. of 1.19.

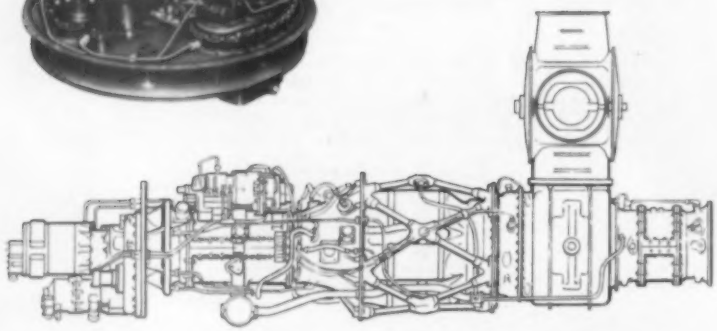


D.H. Super Sprite. A.t.o. droppable rocket pack. Basic motor: length, 117½in, diameter, 20½in. Empty weight, 620 lb; fuelled weight, 1,460 lb. Standard thrust, 4,200 lb for 40 seconds duration; total impulse, 120,000 lb-sec. Propellants: 57 gal hydrogen peroxide at 80 to 85 per cent concentration and 5 gal jet fuel. Feed by 3,690 cu in nitrogen initially at 2,900 to 3,100 lb/sq in. Nacelle: approximate overall dimensions, length, 150in, height 32in and width 28in. Total weight of nacelle and fuelled motor, about 1,900 lb; fall-weight during parachute-jettison cycle, 1,080 lb.



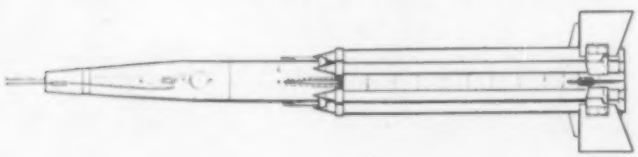
Napier Eland E.151 (NEl.3). Rotodyne powerplant. Ten-stage compressor, six combustion chambers and three-stage turbine, the rotating assembly being coupled to an airscrew reduction gear at the front and (via a fluid clutch) a nine-stage auxiliary compressor at the rear. Overall diameter, about 40in (basic, 36in); length, 158.25in; dry weight, 2,350 lb; mass flow, 31 lb/sec; pressure ratio, 7:1; maximum power (forward flight), 3,000 e.h.p. (2,800 s.h.p. + 500 lb) at 12,500 r.p.m. with s.f.c. of 0.624.

Napier Gazelle NG.1. Free-turbine helicopter engine. Multi-stage compressor, cannular combustion chamber with six flame tubes and independent compressor- and power-turbines. Overall height, about 70in; maximum diameter at intake, 33½in; dry weight, restricted; mass flow and pressure ratio, restricted; maximum rating (5-min), 1,260 s.h.p. (net residual thrust, 260 lb) at 20,400 compressor r.p.m. and output-shaft speed of 3,000 r.p.m.; one-hour rating, 1,100 s.h.p. at 19,800 r.p.m. (output, 3,000 r.p.m.); continuous, 920 s.h.p. at 19,000 r.p.m. (output, 3,300 r.p.m.). Other ratings are NG.2 (1,650 s.h.p.), NG.3 (1,800) and NG.4 (2,000).



Napier Oryx (NOr.5 rating). Single-shaft turbo gas-generator. Twelve-stage compressor, five combustion chambers and two-stage turbine; four-stage auxiliary compressor. Diameter, 19½in; length, 83½in; dry weight, 500 lb; mass flow, 15.3 lb/sec; pressure ratio, 6.15:1 (overall pressure ratio of gas from delivery valve, 1.7:1); maximum output, 950 gas h.p. at 22,600 r.p.m. with s.f.c. of 0.62.

Napier ramjet test vehicle. Free-flying test vehicle for supersonic ramjets, with integral ramjet-duct within body. Launched by eight wrap-round rocket boosters. Diameter, about 18in. No details of weight or performance available.



Rocket Motors. Possibly the most important rocket-motor programme at present in hand for British piloted aircraft is that for the de Havilland Spectre. This unit was first announced in 1955 and unofficial reports, particularly in the foreign Press, have stated that the Spectre will in fact be the rocket motor used in the Saunders-Roe SR.53 supersonic intercepter. It has been designed for both assisted-take-off use and for the propulsion of high-speed and high-altitude aircraft.

De Havilland's earlier experience with rocket motors has centred upon assisted-take-off units arranged as self-contained installations complete with propellent tanks pressurized by nitrogen bottles. For the Valiant, D.H. are in production with the Super Sprite, which was the first liquid-propellent aircraft rocket motor to pass a British type test. It runs on high-test peroxide which is blown through a metal-gauze catalyst to produce a propulsive jet of superheated steam and free oxygen. Into this jet is injected aviation turbine fuel to increase the specific impulse.

D. NAPIER AND SON, LTD. *London, W.3*

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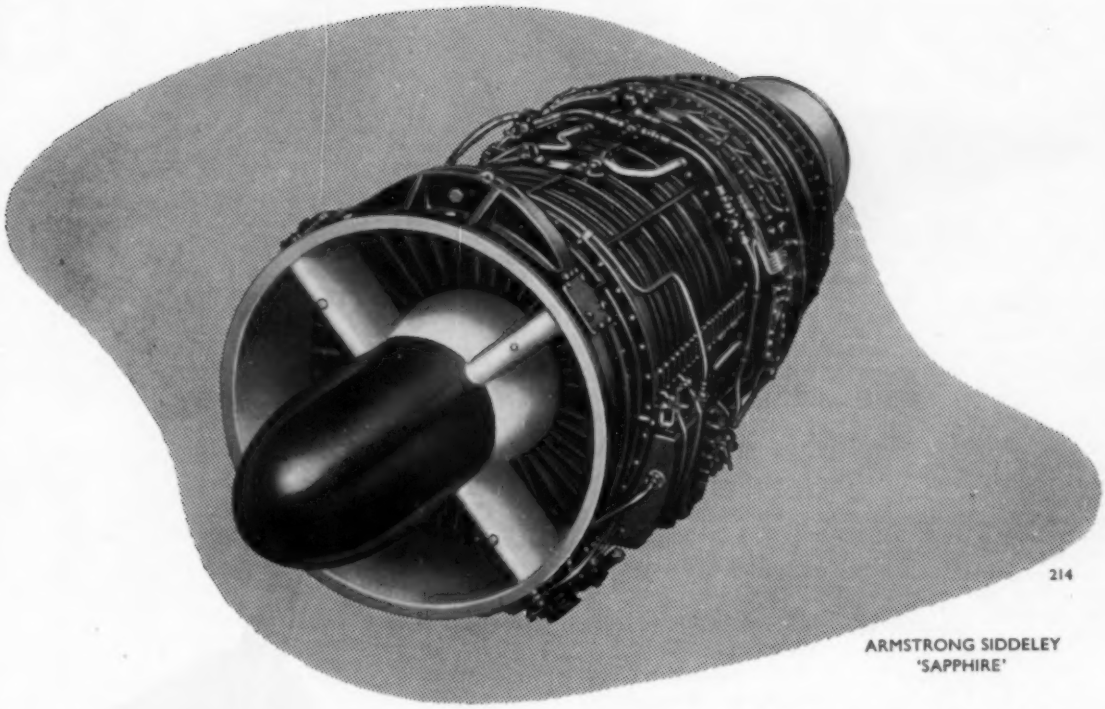
Eland. Unlike most corresponding products of Napier's chief competitors, the Eland is a single-shaft engine. Its compressor is of exceptionally fine design and at the time of its introduction was believed to achieve a record level of work-per-stage. Furthermore, such devices as automatic variable-incidence guide vanes and control of maximum temperature by mercury-vapour sensing units have allowed the Eland to become an exceedingly tractable and easily-handled unit which should become popular with pilots. It should also be a favourite with maintenance and overhaul personnel, since the whole engine can readily be sub-divided into major sections, any of which can be removed without disturbing the remainder.

Elands for fixed-wing aircraft have been extensively flight developed in a Varsity, Elizabethan and Convair 340 and the earlier versions, rated at about 3,000 e.h.p., have been fully type-tested and are virtually capable of carrying fare-paying passengers. A slightly later development is the NEl.6, rated at 3,600 e.h.p. and a specific consumption of not more than 0.595, made possible by a change in turbine-blade material. Later Elands have now been evolved for operation at still higher turbine-inlet temperature. The first of these units was the NEl.4 of 4,000 h.p. which has now been on test for 18 months. The NEl.5, rated at 4,200 e.h.p., is more powerful than any other engine of its size and weight known to be running anywhere in the world, and in cruising flight the specific consumption is expected to be in the order of 0.44, or possibly even lower.

A particularly interesting and unusual engine is the Eland installed in the Rotodyne helicopter. It incorporates an auxiliary compressor which feeds fresh air to kerosine-burning pressure-jets at the tips of the rotor blades. In cruising flight, however, the auxiliary compressor is disconnected, leaving the rotor to autorotate; all the power is then transmitted through the conventional propulsive airscrew which is always driven. This engine, known as the E.151, is described beneath the appropriate photograph; later versions of a similar powerplant are expected to be appreciably more powerful and will correspond with the hot-turbine fixed-wing Elands.

Gazelle. Specially designed to meet the requirements of advanced helicopters, the Gazelle has a pressure ratio, turbine temperature and mass flow carefully chosen to form an effective compromise for such applications. Furthermore, the engine can be installed in any of a great variety of ways and is particularly slim and of light weight.



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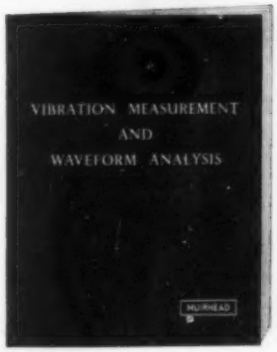

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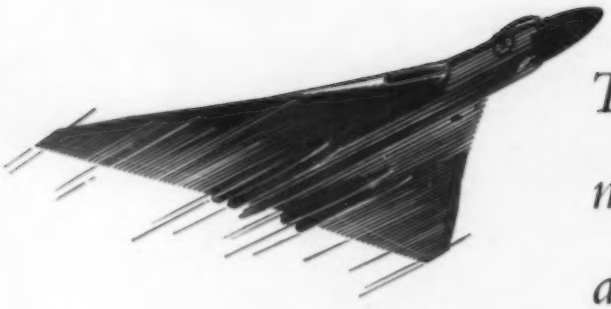

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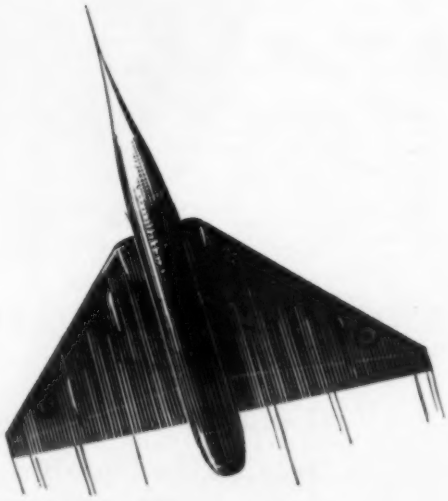

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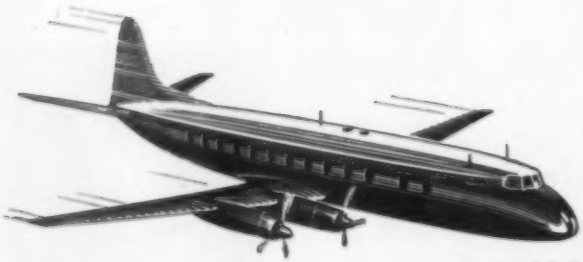

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Oryx. In this unique engine all the power is pushed out in the form of a flow of gas at a temperature and pressure suitable for helicopter tip-jet propulsion without the use of tip-burning. The Oryx has a single rotating assembly comprising an axial compressor, a turbine and an auxiliary compressor. The latter feeds fresh air which is mixed with the exhaust gas to give an output at rather less than 700 deg K at about 23.5 lb/sq in absolute. The engine has been fully type-tested at progressively increased ratings and has greatly exceeded original design figures.

Ramjets. For nearly six years the Napier Flight Development Establishment at Luton have been primarily responsible, under sub-contract from the National Gas Turbine Establishment, for the development of a test vehicle powered by a ramjet arranged integrally with the fuselage. The first vehicle was fired in October 1950 and steady progress has since characterized each succeeding vehicle. The latest patterns have a pitot intake at the front of the integral ramjet-fuselage, a slab-sided centre-body spanning a diameter within the duct and housing the bag-type fuel tanks and control system, together with the associated electronic gear and the fuel pump driven by ram-air turbine. Launching is by means of eight rocket boosters wrapped around the rear of the vehicle in the manner used in some guided-missile programmes.

Earlier this year it was announced by Napier that their ramjet test vehicles had flown to greater altitudes than any other British ramjets and that they had also reached high supersonic Mach numbers while showing very satisfactory performance.

Rocket Motors. At the 1955 S.B.A.C. exhibition Napier were allowed to exhibit the combustion chambers for two rocket motors, one of which was designated N.R.E.17. The production type of chamber was fabricated from sheet steel and had a thrust of approximately 2,500 lb using high-test peroxide and kerosine. Earlier this year the existence was announced of the Napier Scorpion rocket motor which is being air-tested in a Canberra, the installation being made at the rear of the bomb bay. No details of the Scorpion may yet be published.

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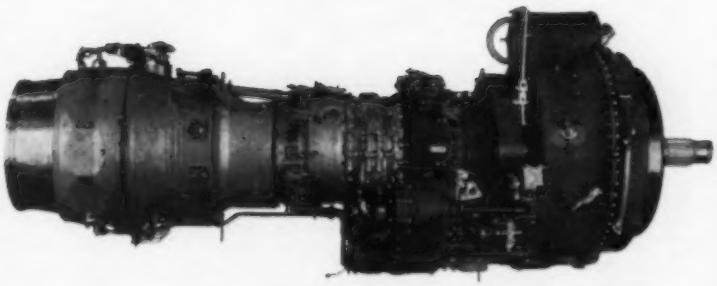
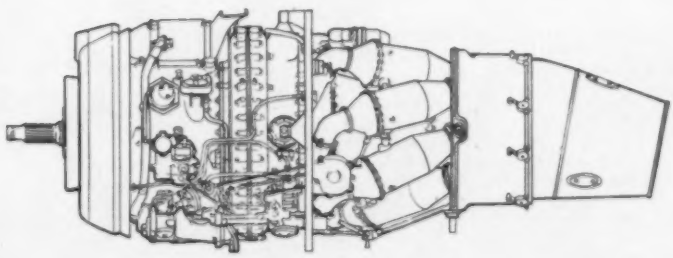


Rolls-Royce Tyne 506 (RTy.1). Two-spool turboprop for transports. Multi-stage low-pressure compressor, multi-stage high-pressure compressor, single-stage high-pressure turbine, three-stage low-pressure turbine and cannular combustion system. Overall diameter, 40.5in; length, 100.25in; dry weight, equipped, 2,023 lb; mass flow, over 41 lb/sec; pressure ratio, 13:1; maximum rating, 4,695 e.h.p. (4,220 s.h.p.) at 15,250 r.p.m.; typical fast cruise rating at 25,000ft at 370 kt, more than 2,640 e.h.p. at 13,500 r.p.m. with s.f.c. of under 0.411.



Rolls-Royce Dart 525 (RDa.7/1). Single-shaft turboprop for transports. Two single-sided centrifugal compressors in series, seven canted combustion chambers and a three-stage turbine. Overall diameter, 38in; length, 98in; dry weight, about 1,250 lb; mass flow, approximately 22 lb/sec; pressure ratio, 5.75:1; maximum rating, 1,990-2,145 e.h.p. (1,800-2,020 s.h.p.) at 15,000 r.p.m.; typical cruising output at 20,000ft at 350 kt, 1,360 e.h.p. (1,285 s.h.p.) at 14,000 r.p.m. with s.f.c. of 0.565.

Dart. For more than three years this famous turboprop has been the only gas turbine in scheduled airline service. As the standard powerplant of the Viscount, it is now employed in all parts of the world and has logged a total of nearly 1½ million hours and has established itself as a unit of quite outstanding reliability. It was originally designed at the end of World War 2 and employs a unique layout which is described in the data beneath the line drawing. The original versions were rated at 1,000 h.p. but this had increased to 1,547 e.h.p. by the time that the first production engine entered service with B.E.A. in April 1953.

Present production is centred mainly upon the Dart 510 rated at about 1,750 e.h.p. and embodying several design changes to increase the service life and improve the operating economy. Early next year the Dart 520, with a three-stage turbine, will come into use for certain types of long-fuselage Viscount. This engine, of which one version is illustrated, delivers a power of the order of 2,000 e.h.p. with still-further-improved economy. Initially it will be cruised at a conservative rating of 13,400 r.p.m. in order to gain experience before going on to the full rating of 14,000 cruising r.p.m.

The ultimate Dart at present envisaged is the RDa. 10 rating in which a very considerable increase in power has been made possible by the adoption of advanced "back-end" techniques involving cooled turbine blading. In the Viscount the RDa. 10 and its developments will be power-limited to 1,800 s.h.p. but will maintain this power up to virtually all normal conditions of airfield, altitude and temperature, thus making water/methanol injection (standard on earlier Darts) largely superfluous except under the most arduous conditions. In the Friendship the later RDa. 10s. will be cleared to operate at no less than 3,150 e.h.p.

Tyne. Not only are the thermodynamic design points of this turboprop as advanced as those of any other gas turbine in the world, but

it makes use of all the unmatched experience which Rolls-Royce have gained in the operation of commercial turboprops. The first prototype Tyne (originally known as the R.B. 109) ran in April 1955, after extensive rig testing had been carried out on all the major portions of the engine. Since that date exceedingly thorough testing has been undertaken to ensure that the Tyne will be as safe and reliable as is humanly possible in the present state of the art. This aspect of the engine's development was referred to in some detail in our issue of August 17.

In April this year a Tyne was put through a 150-hr run to type-test schedule at the design flame temperature, and since then a minor compressor modification has been incorporated which has already taken the power appreciably beyond the figures specified for the first engines. Flight trials began in June with a unit mounted in the nose of a Lincoln and the total running time is now considerably in excess of 1,000 hr. Endurance flying will be undertaken with an Elizabethan which may be employed on scheduled freight operations by B.E.A. At present the principal application of the Tyne is as the standard powerplant of the Vanguard transport, in which it will drive a 14ft 6in de Havilland airscrew. The engine is also clearly suitable for use in such aircraft as the Lockheed Electra. Certificated engines are scheduled to be delivered in the winter 1958-59 and B.E.A. expect to start operations early in 1960. Later versions of the engine will be substantially more powerful than the figures quoted in the data given on p. 391.

Avon. This name is applied to the largest family of turbojets in the world, the various members of which have now been delivered in thousands and for six years have been employed in bombers, fighters, trainers, airline transports and experimental aircraft including vertical-take-off prototypes.

The first basic types of Avon were similar to the RA. 21 illustrated. Such units are now widely employed in all parts of the world in Canberras, Hunters, R.A.F. Comets and several machines of foreign design. Generally similar engines have been manufactured by several companies in Great Britain and are also being built in Sweden, Belgium and Australia. In Canberras they have frequently run 800 hr between overhauls.

Later Avons of the 200 series are still subject to security restrictions but their design is clearly very advanced and they are among the most powerful and efficient units of their size and weight to be found anywhere in the world. One of the most important of these late-model Avons is the commercial RA.29 rated at 10,500 lb dry take-off thrust and capable of cruising at a very low turbine-inlet temperature in order to achieve an extraordinarily competitive specific consumption (and also, no doubt, a remarkable overhaul life). The latest military Avons employ air-cooled turbine blading and deliver thrust very much higher than any values so far announced.

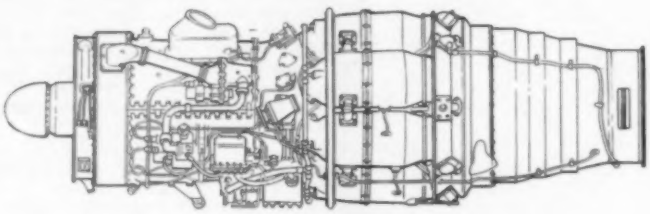
R.B. 106. No official mention has yet been made of any engine with this designation, but references to such a unit have appeared several times in various publications. All such reports referred to it as a high-thrust turbojet and it is described as having a two-spool layout. An American report states that Westinghouse are anxious to manufacture it under licence.

R.B. 108. This is a new gas turbine, examples of which are now on bench test. No details whatever may be published.

Centrifugal Engines. Contracts for the 3,600 lb-thrust Derwent were completed early last year after many thoustands had been delivered.

The Rolls-Royce Scottish factories are now on the "home stretch" in development and manufacture of Nenes of which there are several versions rated in the 5,000 to 6,000 lb thrust class. The latest engines have been used exclusively in the Sea Hawk fighter, a unique feature of these units being the bifurcated jet pipe exhausting on each side of the rear fuselage. The Sea Hawk engine is rated at the RN.6 figure of 5,400 lb; production has actually stopped at present but further deliveries may be required.

Rolls-Royce Avon 200-series (RA.28). Turbojet. Multi-stage compressor, annular combustion chamber and multi-stage turbine. Overall diameter, 41.5in; length, 113.3in; dry weight, 2,890 lb; mass flow, reported to be 160 lb/sec; pressure ratio, reported to be 8:1; maximum rated thrust, 10,000 lb with s.f.c. of 0.86.



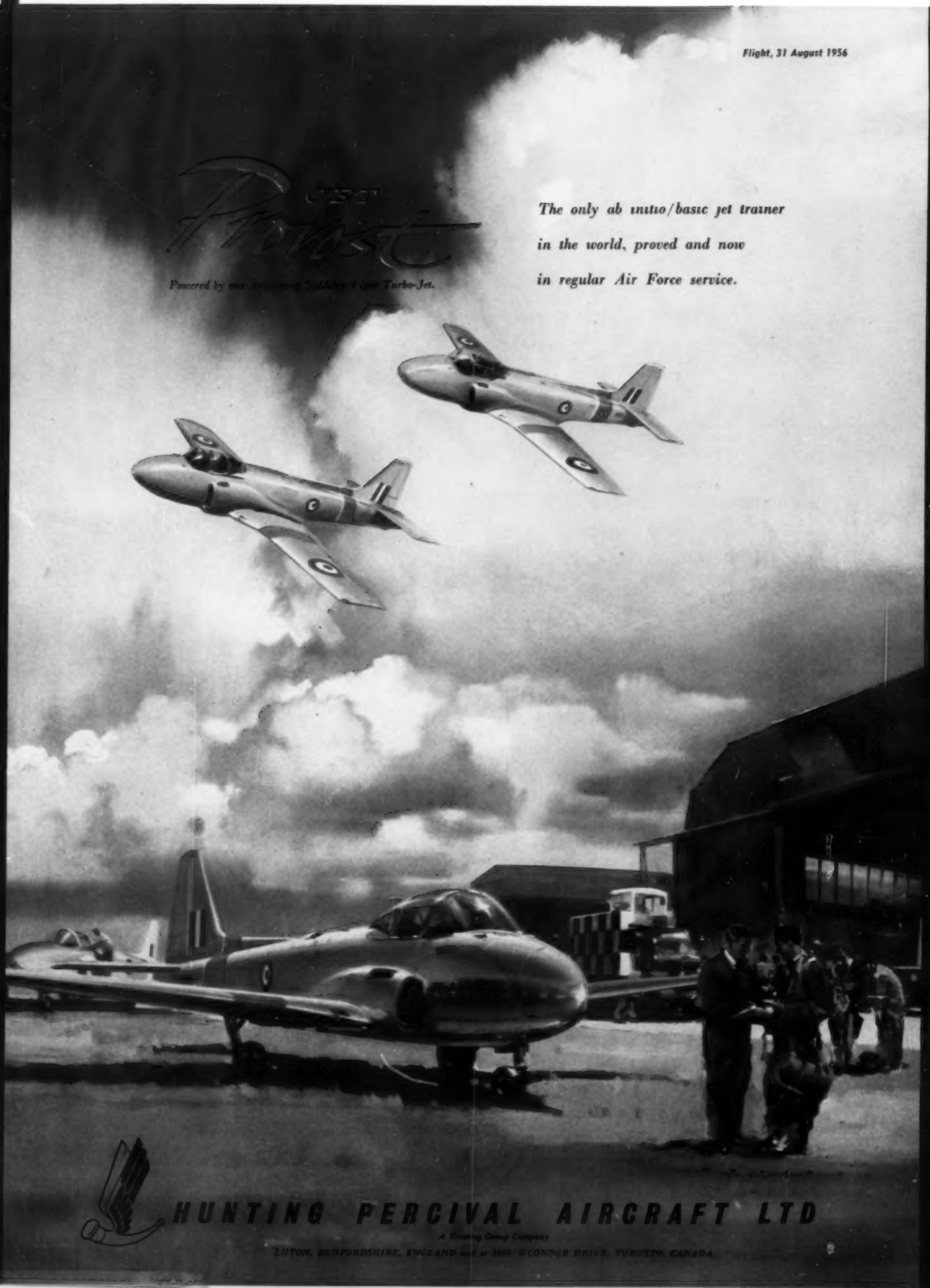
Rolls-Royce Avon RA.21. Fighter turbojet. Twelve-stage compressor, eight combustion chambers and two-stage turbine. Diameter, 42.2in; length as shown, 102.1in; dry weight, 2,520 lb with full equipment; mass flow, about 130 lb/sec; pressure ratio, about 7:1; maximum thrust, 8,000-8,050 lb at 7,900 r.p.m. with s.f.c. of 0.925. Engines of this rating can be equipped with an afterburner.

Piston Engines. Many hundreds of re-conditioned Merlins have been supplied to Spain during the past few years and deliveries against a new contract worth about £1 million began in the spring of this year. The larger Griffon remains in production for Shackletons at the company's Scottish factories and Sea Griffons for R.A.F. launches are also being delivered.

Rocket Motors. In the spring of 1955 Rolls-Royce entered into a licence agreement with North American Aviation, Inc., allowing them to manufacture and develop high-thrust rocket motors using techniques evolved by the American company. N.A.A. have long been world leaders in the sphere of large-size rocket motors and it has been widely reported that Rolls-Royce intend to manufacture exceedingly powerful units suitable for long-range ballistic missiles and similar applications. It has also been reported that such motors may be ground-run at the testing station which the Ministry of Supply are expected to construct at Spadeadam Waste in Cumberland.

Nuclear Power. During the past two years Rolls-Royce have been actively engaged in research into power systems based upon atomic reactors. A company statement earlier this year announced that effort was being applied to the development of light-weight reactors which would ultimately be suitable for air- and surface-transport applications; the statement added that experimental work on high-temperature liquid metals began in July last year.

In March 1956 Vickers Nuclear Engineering was formed by Rolls-Royce, Vickers and Foster Wheeler. In view of the constitution of this company it seems likely that one of the first Rolls-Royce nuclear applications will be of a marine nature.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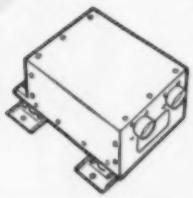
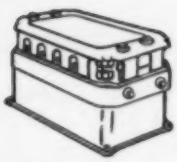
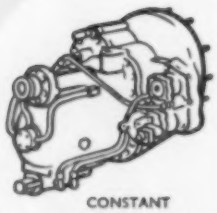
ALTERNATORS



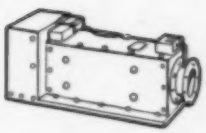
ALTERNATOR CONTROL PANELS



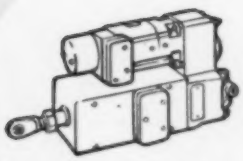
CIRCUIT BREAKERS



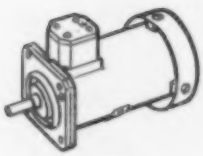
CONSTANT SPEED DRIVES



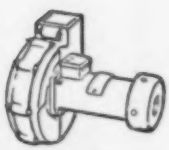
TRANSFORMER RECTIFIER UNITS



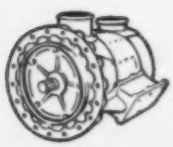
LINEAR ACTUATORS



MOTORS



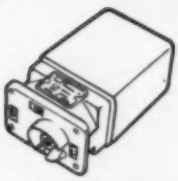
BLOWERS



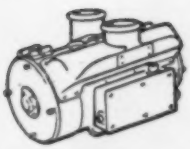
GENERATORS

aircraft equipment

TRANSFORMERS



ROTARY ACTUATORS



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Conway. Two weeks ago we had occasion to outline the development of this remarkable engine in some detail. As is now well known it is the solitary example of the by-pass engine, which has long been understood in principle but has received little support in practice.

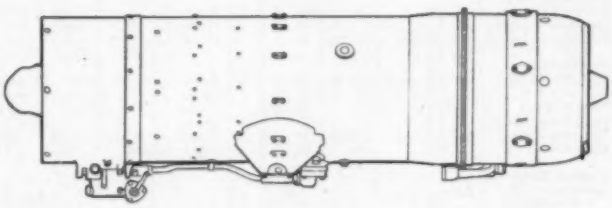
Broadly the engine can be considered as a modified "two-spool" turbojet with an over-sized low-pressure compressor. The excess air delivered by the outer portions of this compressor is passed around the remainder of the engine and finally emerges as a propulsive jet which, in relation to the gas flow from the combustion system and turbine, is relatively cool and slow-moving. Such an engine "gets the best of both worlds" to a considerable extent, since the high combustion temperature confers good cycle efficiency while the reduced mean jet velocity raises the Froude, or propulsive, efficiency.

Several types of Conway have been developed, with steadily increasing thrust. Last year the RCo.5 was fully type-tested at a thrust of 13,000 lb dry, with a specific fuel consumption announced as lower than that of any other type-tested turbojet— which implies a value at least as good as 0.75. In view of the cessation of development upon the Conway's original (British) application the last twelve months have seen Rolls-Royce steadily preparing versions of the engine matched to the requirements of the large American jet transports, the Boeing 707 and Douglas DC-8. Both these aircraft need appreciably more than 13,000 lb thrust per engine and later families of Conways are therefore in prospect giving very high thrust indeed.

It has been announced that production orders will be placed by the Ministry of Supply for a high-thrust military Conway suitable for use in one or more types of "V-bomber." This will not only markedly increase the performance of these aircraft but will allow Rolls-Royce to obtain an invaluable background of several thousand hours of flying preparatory to offering the corresponding commercial engine for passenger service. The airline unit will be somewhat less powerful than the later military Conway, and should be ideal for the American applications.

The first order was placed earlier this year, by Trans-Canada Air Lines, who specified Conways for their DC-8s, deliveries of which are to start in November 1959. B.O.A.C. are regarded as a certain customer for the engine for their forthcoming long-range jet order and a significant announcement, made earlier this month, was the selection of the Conway by the German operator, Lufthansa, in place of an American engine originally specified for their Boeing 707s. It has been reported that the Conway will be lighter, cheaper and more efficient than any American engine capable of doing the same job.

Rolls-Royce Conway (RCo.5 rating). By-pass turbojet. Multi-stage low-pressure compressor, intermediate diffuser with flow divider to by-pass duct, multi-stage high-pressure compressor, annular combustion chamber with 10 Duplex burners and two sets of mechanically independent turbine stages. Overall diameter, 41.5in; length as shown, 128.8in; type-tested thrust, 13,000 lb. All other data restricted.



Rolls-Royce Soar RSr.2. High specific-thrust turbojet. Monocoque construction, with axial compressor, annular (high-intensity) combustion chamber and single-stage turbine. Data applicable at end of 1954: overall diameter, 15.8in; overall length as shown, 62.75in (58.95in without generator fairing or 77in with air intake); dry weight as shown, 267 lb (275 lb with air intake); mass flow and pressure ratio, restricted; maximum thrust, 1,810/1,860 lb with s.f.c. of 1.26.

Soar. When it was first announced in 1954 this tiny turbojet was easily the lightest and smallest air-breathing unit, thrust for thrust, yet developed, and no other engine has yet been able to challenge it publicly. Owing to its nature it has not been much in the news in the past two years but development of this type of engine is most active. The lifting jets envisaged for future types of vertical take-off machines have been referred to as "distant cousins" of the Soar, and Westinghouse build a similar engine in Kansas City, under a licence-agreement. The only announced applications for the Soar have been as a powerplant for small, high-speed targets.

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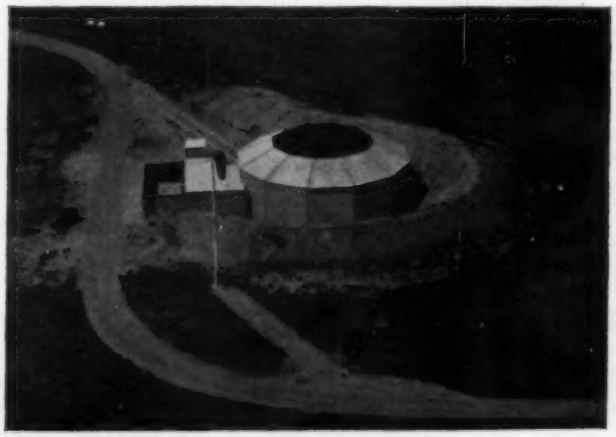
Pulsejets. For several years this versatile company have been evolving a range of small flapper-valve pulsejet units for a number of applications, which include helicopter rotor tip-drive. In 1953 a 45-lb-thrust unit was revealed, and this was later supplemented by a larger pulsejet rated at 120 lb thrust. Originally the work was on a private-venture basis, but it is now being carried out under contract and no details may be given. The accompanying photograph depicts a test house wherein pulsejets are whirled on a rotating arm.



BRITISH MILITARY AIRCRAFT 1956

(INCLUDING RESEARCH AIRCRAFT AND CERTAIN MILITARY TYPES NOW OUT OF PRODUCTION)

Maker and Type	Main Duties	Span ft	Span in	Length ft	Length in	Power Unit(s) No.	Power Unit(s) Type	Power Unit(s) Power (see note 1)	Normal gross wt lb	Wing Loading lb/sq ft	Armament (see note 2) Guns No. Cal. mm	Armament (see note 2) Bombs No. Wt. lb	Armament (see note 2) R.P.s No. Wt. lb	Max. speed m.p.h.	Max. speed ft	Climb to ft	Climb min	Typical Range miles
Armstrong Whitworth:																		
Meteor N.F.14 ...	F. ...	43	0	49	11	2	Derwent ...	7,000	20,000	n.r.	4 20	nil	nil	590	n.r.	n.r.	n.r.	n.r.
Sea Hawk FGA.4 and 6	F.B. ...	39	0	40	0	1	Nene	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	630	n.r.	n.r.	n.r.	n.r.
Auster:																		
A.O.P.9 ...	O.C.	36	5	23	8½	1	Bombardier 203	180	2,125	10.4	nil	nil	nil	127	—	i.r.c.=	920 ft/min	240
Avro:																		
Vulcan B.1	B. ...	99	0	97	1	4	Olympus ...	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Shackleton M.R.2 ...	R.A.-S.	120	0	87	4	4	Griffon	n.r.	86,000	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Shackleton M.R.3 ...	R.A.-S.	126	6	87	4	4	Griffon	n.r.	n.r.	n.r.	2 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
707C	T. ...	34	2	42	9	1	Derwent ...	3,500	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Blackburn and General Aircraft:																		
Beverley	Tt. ...	162	0	99	5	4	Centaurus (D.P.I.)	12,600	143,000	45.5	nil	nil	nil	242	—	i.r.c.=	760 ft/min	1,600
Boulton Paul:																		
Balliol T.2	T. ...	39	4	35	1	1	Merlin 35 ...	1,280	8,410	33.64	1 7.7	8 25	4 60	288	9,000	10,000	6	670
Sea Balliol T.21 ...	T. ...	39	4	35	1	1	Merlin 35 ...	1,280	8,704	34.81	1 7.7	8 25	4 60	285	9,000	10,000	6	655
P.111A	R'ch.	33	6	26	1	1	Nene	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
de Havilland:																		
D.H.110 Mk 20 ...	F. ...	51	0	52	0	2	Avon	n.r.	n.r.	n.r.	4 30	n.r.	missiles	n.r.	n.r.	n.r.	n.r.	n.r.
Venom F.B.4	F.B. ...	41	9	33	0	1	Ghost	n.r.	n.r.	n.r.	4 20	2 1,000	8 60	n.r.	n.r.	n.r.	n.r.	n.r.
Venom N.F.3	F. ...	41	9	35	3	1	Ghost	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Sea Venom N.F.21 ...	F. ...	41	9	35	3	1	Ghost	n.r.	n.r.	n.r.	4 20	n.r.	8 60	n.r.	n.r.	n.r.	n.r.	n.r.
Vampire Trainer ...	T. ...	38	0	34	6	1	Goblin 35 ...	3,500	11,680	44.7	4 20	opt.	8 25	538	s.l.	30,000	14	789
Chipmunk T.10 ...	T. ...	34	4	25	5	1	Gipsy Major 8 ...	145	2,014	11.57	nil	nil	nil	138	s.l.	5,000	7	280
English Electric:																		
Canberra P.R.3, T.4, B.6 and B(I).6 ...	B.R.T.	64	0	65	6	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra P.R.7 ...	R. ...	64	0	66	8	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra B(I).8 ...	B.I. ...	64	0	65	6	2	Avon	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra P.R.9 ...	R. ...	68	0	66	8	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
P.1 (see note 4) ...	F. ...	36	0	54	0	2	Sapphire or Avon	n.r.	n.r.	n.r.	n.r.	nil	missiles	n.r.	n.r.	n.r.	n.r.	n.r.
Fairey:																		
Gannet A.S.1, 4 and T.2	A.-S.T.	54	4	43	0	1	Double Mamba	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
F.D.2	R'ch.	27	0	52	0	1	Avon	n.r.	n.r.	n.r.	nil	nil	nil	over 1,132	38,000 approx.	n.r.	n.r.	n.r.
Firefly Mk. 8	Tar.	43	6	38	3	1	Griffon 59 ...	n.r.	15,800	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Folland:																		
Gnat	F.B. ...	22	2	29	0	1	Orpheus ...	n.r.	n.r.	n.r.	2 30	2 1,000	8 R.P.s	n.r.	n.r.	n.r.	n.r.	n.r.
Gloster:																		
Javelin FAW.1, 4 and 7	F. ...	52	0	57	0	2	Sapphire ...	n.r.	n.r.	n.r.	4 30	nil	missiles	n.r.	n.r.	n.r.	n.r.	n.r.
Meteor F.8	F.B. ...	37	2	44	7	2	Derwent 8 ...	7,000	15,700	44	4 20	2 1,000	16 60	595	10,000	40,000	11.4	690
Handley Page:																		
Victor B.1	B. ...	110	0	114	11	4	Sapphire ...	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hawker:																		
Hunter F.4	F.B. ...	33	8	45	3	1	Avon	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter F.5	F.B. ...	33	8	45	3	1	Sapphire ...	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter F.6	F.B. ...	33	8	—		1	Avon	n.r.	n.r.	n.r.	4 30	2 1,000	24 60	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter Two-Seater (T.7)	T. ...	33	8	48	10	1	Avon	n.r.	n.r.	n.r.	2 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunting Percival:																		
Provost T.1	T. ...	35	2	28	8	1	Leonides 25 ...	550	4,300	20.1	2 7.7	8 25	6 60	200	2,300	10,000	7	630
Jet Provost T.2 ...	T. ...	35	5	31	11	1	Viper ASV.8 ...	1,750	6,050	28.3	nil	nil	nil	330	35,000	30,000	21	580
Pembroke C.1 ...	Tt. T.	64	6	46	0	2	Leonides ...	1,100	12,800	32	nil	nil	nil	220	2,000	10,000	10.5	1,030
Miles:																		
Student	T. ...	28	0	27	0	1	Marboré II ...	880	3,100	22	nil	nil	nil	302	20,000	20,000	14	476
M.L. Aviation:																		
Light Aircraft Mk. 1 ...	Utility	35	0	23	3	1	Walter Mikron III	—	935	2.3	nil	nil	nil	68	—	i.r.c.=	740 ft/min	145
Saunders-Roe:																		
SR.53	F. ...	—		—		—	Rocket and turbojet ...	—	—	—	n.r.	—	Missiles	—	—	—	—	—
Short:																		
S.B.5 (see note 3) ...	R'ch.	30	6	45	9	1	Derwent ...	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Seamew A.S.1	A.-S. ...	55	0	41	0	1	Mamba ASM.6...	1,770	13,884	23.7	nil	4 depth charges	6 R.P.s	242	s.l.	i.r.c.=	1,600 ft/min	550
Seamew M.R.2 ...	A.-S. ...	55	0	41	0	1	Mamba ASM.6...	1,770	14,834	25.2	nil	4 depth charges	6 R.P.s	—	—	—	—	—
P.D.11	V.T.O.R.	—		—		—	—	—	—	—	nil	nil	nil	—	—	—	—	—
Vickers-Armstrongs:																		
Valiant B.1, B(PR)1 and B(PR)K.1	B.R. ...	114	4	108	3	4	Avon	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Vickers-Supermarine:																		
Swift F.R.5	F.R. ...	32	4	42	3	1	Avon	n.r.	n.r.	n.r.	2 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Swift Mk7	F. ...	n.r.		n.r.		1	Avon	n.r.	n.r.	n.r.	n.r.	nil	4 missiles	n.r.	n.r.	nr.	n.r.	n.r.
N.113	F.B. ...	37	2	55	4	2	Avon	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Westland:																		
Wyvern S.4	Strike	44	0	42	0	1	Python ASP 3 ...	4,110	21,200	59.7	4 20	2 1,000	16 60	383	s.l.	i.r.c.=	2,350 ft/min	900

Abbreviations: A.-S.=Anti-submarine; B.=bomber; C.=communications; F.=fighter; I.=intruder; i.r.c.=initial rate of climb (ft/min); n.r.=not released; O.=observation; R.=reconnaissance; R'ch.=research; r.o.c.=rate of climb; R.P.=rocket projectile; s.l.=sea level; Tar.=target; T.=training; Tt.=transport;
Notes: (1) For piston engines, power (in h.p.) is for take-off; for turbojets, thrust (in lb) is static. (2) Bomb and R.P. loads are generally alternatives. (3) Dimensions are for 60 deg sweepback. (4) Dimensions are approximate.

BRITISH CIVIL AIRCRAFT 1956

(INCLUDING TYPES NOT YET IN PRODUCTION)

Maker and Type	Span	Length	Power Unit(s)			Normal a.u.w.	Wing Loading	Max. Disposable Load	Volumetric Payload Capacity	No. of Pass.	Cabin Air (see note 2)	Max. Still-Air Range	Typical Performance				Representative Field Length (I.S.A.)
			No.	Type	Power (see note 1)								Distance miles (see note 3)	Height	Speed	Payload	
	ft in	ft in				lb	lb/sq ft	lb	lb			miles		ft	m.p.h.	lb	yd (see note 4)
Auster:																	
Aiglet Trainer ...	32 0	23 2	1	Gipsy Major 1	120	1,850	11.3	877	—	1/2	—	—	275	1,000	109	—	330
Autocar	32 0	23 2	1	Cirrus Major 3	140	2,450	13.3	1,091	—	3	—	—	520	1,000	110	650	380
Agricola	42 0	27 6	1	Continental O-470-B	240	3,840	15.1	1,680	—	2	—	260	—	—	107	1,680	450
Aviation Traders:																	
Accountent ...	82 6	60 6	2	Dart 512	3,480	28,500	45	12,400	6,000	28/36	P.	—	500	20,000	285	8,000	1,040(c)
Blackburn																	
Universal ...	162 0	99 2	4	Centaurus 873	12,880	143,000	49	61,260	50,000	160	—	3,680	500	8,000	180	48,000	1,260(c)
Bristol:																	
Britannia 100 ...	142 3½	114 0	4	Proteus 705	15,120	150,000	73	68,000	25,000	83	P.	6,300	4,100	29,400	340	25,000	1,850(c)
Britannia 310/320	142 3½	124 3	4	Proteus 755	16,480	175,000	84	93,000	28,000	64/133	P.	(see note 6)	3,800	30,200	350	28,000	2,120(c)
de Havilland:																	
Comet 4	115 0	111 6	4	Avon RA.29	42,000	152,500	71.4	—	19,300	58/76	P.	—	2,700	42,000	506	19,300	2,160(c)
Comet 4A ...	108 0	114 10	4	Avon RA.29	42,000	152,500	75	—	22,690	70/92	P.	—	1,880	23,500	530	22,690	2,160(c)
Dove 5	57 0	39 3	2	Gipsy Queen 70 Mk 2	760	8,800	26.3	2,420	1,800	811	—	1,153	490	8,000	179	1,672	810
Heron 2	71 6	48 6	4	Gipsy Queen 30 Mk 2	1,000	13,150	26.3	—	3,050	11/17	—	1,375 (see note 7)	690	8,000	183	2,926	865(c)
Handley Page:																	
Herald	94 9½	70 3	4	Leonides Major	3,480	37,500	42	12,325	10,100	36/44	P.	1,350	600	10,000	180	8,000	976(c)
Hunting Percival:																	
Prince 3	56 0	42 10	2	Leonides 502/4	1,100	11,000	30.2	3,190	3,000	8/12	—	1,107	650	5,000	151	1,660	800
President	64 6	46 0	2	Leonides 503/4	1,100	13,500	33.7	4,547	3,960	12	—	1,500	920	8,000	150	2,600	1,265(c)
Miles:																	
Aries	36 2	22 3	2	Cirrus Major 3	310	3,475	18	—	—	4	—	675	500	1,000	150	650	425
H.D.M.106 ...	75 4	37 10	2	Lycoming GO-480	580	8,000	28.8	4,200	3,040	15	—	800	780(s)	5,000	122	2,460	580
Scottish Aviation:																	
Pioneer 2	49 9	34 6	1	Leonides 502/4	520	5,800	14.9	—	1,500	4	—	420	350	5,000	121	1,300	230
Twin Pioneer ...	76 6	45 3	2	Leonides 502/1	1,100	13,500	20.5	4,323	3,800	14/16	—	570	500(s)	5,000	125	2,700	376
Edgar Percival Aircraft:																	
Edgar Percival E.P.9	43 6	30 0	1	Lycoming GO-480-B	270	3,675	16.1	1,825	—	6	—	575	—	—	126	1,825	300
Vickers-Armstrongs:																	
Viscount 700D ...	93 8½	81 2	4	Dart 510	6,960	60,000	60.75	25,425	11,630	40/53	P.	(see note 8)	1,400	20,000	321	10,000	1,553(c)
Viscount 810/840...	94 0	85 7	4	Dart 520	7,960	67,500	70	26,774	13,500	44/70	P.	—	1,000	20,000	400(9)	13,500	1,860(c)
Vanguard... ...	118 0	122 4	4	Tyne	16,080	135,000	88.5	63,500	21,000	76/115	P.	3,340	2,600	30,000	402	21,000	1,600(c)

Notes: (1) For piston engines, power (in h.p.) is for take-off; for turboprops, an equivalent shaft horsepower is given; for turbojets, thrust (in lb) is static (2) P=pressurized. (3) Where possible, a typical stage-length with allowances is given; (s) indicates still-air range. (4) Distance accompanied by (c) includes allowances for engine-out. (5) 20 passengers and three cars. (6) The maximum range of the Britannia 100 with full tanks and 15,000 lb payload is 5,270 miles; corresponding figures for the Britannia 310/320 are 5,870 miles with 18,000 lb (max tankage 8,486 Imp gal) using long-range procedure. (7) Stage-length with five passengers and baggage. (8) 2,410 miles with slipper tanks; 2,190 miles with standard tankage. (9) 840.

HELICOPTERS

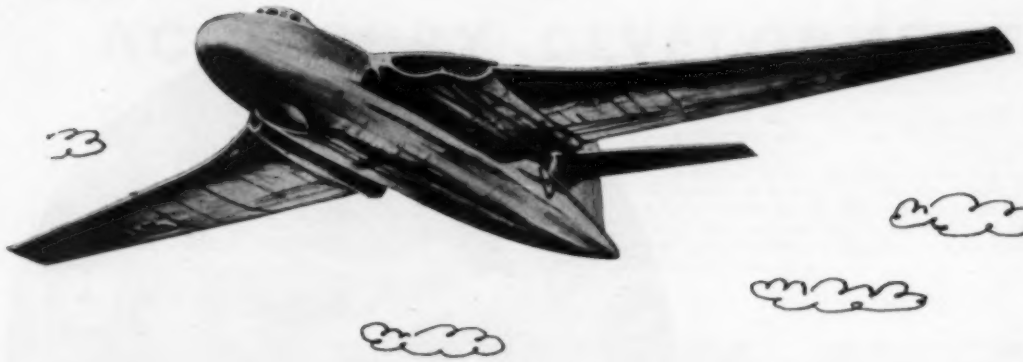
Maker and Type	Main Rotors	Rotor Diam.	Fuselage Length	Power Unit(s)			Gross Weight	Disc Loading	Disposable Load	No. of Pass.	Typical Performance			
				No.	Type	Power					Range	Height	Speed	Payload
		ft in	ft in			h.p.	lb	lb/sq ft	lb		miles	ft	m.p.h.	lb
Bristol:														
Type 171 Mk 4 (Sycamore) ...	1	48 6.7	42 0	1	Leonides	545	5,400	2.87	1,390	3/4	270	s.l.	91	706
Type 173 Mk 1	2	48 6.7	55 1.7	2	Leonides	1,090	10,600	2.86	2,800	10	100	2,500	85	1,200
Type 192	2	48 6	50 2.7	2	Leonides Major ...	1,740	17,200	—	6,000	25	n.r.	n.r.	92	n.r.
Type 192	2	48 6	50 2.7	2	Gazelle	—	18,000	—	—	25	—	—	138	5,000
Fairey:														
Rotodyne (see Note 1)	1	90 0	58 8	2	Eland NEI.3 ...	6,000	33,000	—	13,000	40	90	—	180	—
Ultra-Light	1	28 3	—	1	Palouste	258	—	—	—	1	—	—	—	—
Saunders-Roe:														
Skeeter 6	1	32 0	28 5	1	Gipsy Major 201	200	2,150	2.6	—	1	—	—	99	—
Westland-Sikorsky:														
Whirlwind Mk 5	1	53 0	41 8.5	1	Leonides Major ...	850	8,000	—	—	10	—	—	86	—
Widgeon	1	49 2	41 2.75	1	Leonides	545	5,900	—	—	4	—	—	80	—
Wessex	1	—	—	1	Gazelle	n.r.	12,600	—	—	12	440	—	125	—
Westminster	1	—	—	2	Gas turbines ...	—	33,000	—	13,000	40	356	—	150	—

Notes: (1) Figures are for first prototype. Later models will be much superior.

BRITISH POWER UNITS 1956

Maker and Type	Classification	Swept vol. (litres) or mass flow (lb/sec)	Max boost (lb/sq in) or press. ratio	Max. rated power				Typical cruising s.f.c.	Power/weight ratio (per lb)	Remarks
				s.h.p.	lb thrust	r.p.m.	s.f.c.			
Alvis:										
Leonides 503/8 ...	P, 9r, air	11.78 lit	8 lb/sq in	570	n.a.	3,000	—	0.50	0.73	Typical fixed-wing Leonides.
Leonides 524/1 ...	P, 9r, air	11.78 lit	7 lb/sq in	565	n.a.	3,200	—	0.49	0.892	Vertical helicopter engine.
Leonides Major 1-1	P, 14r2, air	18.28 lit	8 lb/sq in	850	n.a.	2,900	0.72	0.48	0.74	Fixed-wing Major.
Leonides Major 1-2	P, 14r2, air	18.28 lit	8 lb/sq in	850	n.a.	2,900	0.72	0.48	0.85	Any-angle helicopter engine.
Armstrong Siddeley:										
Double Mamba ASMD.3	T, 2 (10a, 6cc, 2t)	37 lb/sec	5.35:1	2,740	770	15,000	0.71	—	1.383	Two independent power sections.
Mamba ASM.6 ...	T, 11a, ann, 3t	20+ lb/sec	6:1	1,650	320	15,000	0.69	—	1.86	Seamew engine. Also civil ASM.7.
Sapphire ASSa.7 ...	J, a, ann, t	n.r.	n.r.	n.a.	10,500	8,600	0.885	n.r.	3.41	Production at this rating.
Sapphire ASSa.12 ...	J, 13a, ann, 2t	n.r.	n.r.	n.a.	8,500	8,600	0.92	0.85	3.16	Standard engine with cast turbine blades.
Screamer ASSc.1 ...	R, LO_2+Avtur	37 lb/sec	n.a.	n.a.	8,000	n.a.	10.8	—	17	Self-contained, with turbopump.
Viper ASV.5 (101)	J, 7a, ann, 1t	30 lb/sec	3.5:1	n.a.	1,640	13,400	1.09	—	3.142	Long-life engine.
Viper ASV.10 ...	J, 7a, ann, 1t	42 lb/sec	4:1	n.a.	2,000	13,800	1.01	—	3.52	To be standard trainer engine.
Blackburn:										
Bombardier 702 ...	P,4l, inv., air	6.524 lit	n.a.	173-220	n.a.	2,600	—	0.45	0.5-0.6	Direct-injection engine.
Artouste 610 ...	T,1c, ann, 2t	7.2 lb/sec	4.12:1	475	—	34,000	0.99	—	1.72	Single-shaft engine.
Palas 600	J, 1c, ann, 1t	7.2 lb/sec	4.12:1	n.a.	350	34,000	1.1	—	2.1	
Palouste 500 ...	GP, 1c, ann, 1t	4.7 lb/sec	4.19:1	258 g.h.p.	2.725 lb air/sec at 57.25 lb/sq in for 310 lb fuel per hour at 35,000 r.p.m.					Air-producer for helicopters
Turmo BnT.1 ...	T, 1c, ann, t+t	7.19 lb/sec	4.12:1	450	—	36,000	1.04	—	1.61	Free-turbine drive at rear.
Coupled Turmo ...	T, 2 (1c, ann, t+t)	14.38 lb/sec	4.12:1	908	—	36,000	1.04	—	—	Any-angle helicopter engine.
Bristol:										
Centaurus 373 ...	P, 18r2, air	53.6 lit	13 lb/sq in	3,220	n.a.	2,800	—	0.42	0.92	Direct fuel-injection engine for Beverley.
Hercules 758 ...	P, 14r2, air	38.7 lit	13 lb/sq in	2,090	n.a.	2,800	—	0.42	1.00	Sleeve valves.
Orion	T, 7a+5a, ann, t+3t	82 lb/sec	10+ :1	4,400	1,950	10,000*	—	0.38	1.89	Constant power to 15-25,000ft.
Olympus 102 ...	J, a+a, ann, t+t	*165+ lb/sec*	*10+ :1*	n.a.	12,000	6,500*	*0.79*	*0.75*	4.21	Vulcan engine. Also more powerful versions.
Orpheus BOr.3 ...	*J,7a, ann, t*	n.r.	n.r.	n.a.	4,850	n.r.	0.99	n.r.	6.5	For Gnat, Fiat G.91 and other types.
Proteus 755 ...	T, 12a+1c, 8cc, 2t+2t	43·8 lb/sec	7.2:1	3,670	1,220	12,000	0.6	0.45	1.46	Free-turbine engine; r.p.m. is for compressor.
Thor BT.1	RJ, supersonic	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Double-shock intake. Over 200 test vehicles fired.
Zeus	*J, two-spool*	—	—	n.a.	*18,000+*	—	—	—	—	Unofficial report.
Budworth:										
45/60	T, 1c, ann, t	—	—	60	n.a.	45,000	1.4	—	1.0	Weight includes 15:1 reduction gear.
de Havilland:										
Gipsy Major 200 ...	P, 4l, inv. air	6.79 lit	n.a.	200	n.a.	2,600	—	0.51	0.50	Direct fuel injection
Gipsy Queen 30/2...	P, 6l, inv, air	10.2 lit	n.a.	250	n.a.	2,500	—	0.51	0.476	Unblown, direct drive.
Gipsy Queen 70/2...	P, 6l, inv, air	10.2 lit	7.5 lb/sq in	380	n.a.	3,000	—	0.46	0.526	Blown, geared, injection carb.
Ghost 105	J, 1c, 10cc, 1t	88.5 lb/sec	4.7:1	n.a.	5,300	10,350	1.19	—	2.5	Air-cooled nozzle guide vanes.
Goblin 35	J, 1c, 16cc, 1t	63 lb/sec	3.67:1	n.a.	3,500	10,750	1.14	—	2.15	
Gyron DGy.1 ...	J, a, ann, t	n.r.	n.r.	n.a.	15,000	n.r.	n.r.	n.r.	n.r.	Various versions; supersonic applications.
Gyron Junior DGJ.1	J,	n.r.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	n.r.	Reported to be scaled-down Gyron; see p. 389.
Spectre	R,	n.r.	n.a.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	DSpe. 1 to 5 ratings announced.
Super Sprite ...	R, H_2O_2+Avtur	—	n.a.	n.a.	4,000	n.a.	—	—	2.75	Jettisonable a.t.o. motor for Valiant.
Napier:										
Eland NEI.1 ...	T, 10a, 6cc, 3t	31 lb/sec	7:1	2,690	825	12,500	0.624	0.493	1.91	
Eland NEI.3 ...	T/GP, 10a, 6cc, 3t + aux comp.	31 lb/sec	7:1	2,805	520	12,500	0.624	0.493	1.28	For Rotodyne.
Eland NEI.5 ...	T,	35 lb/sec	n.r.	3,765	1,125	12,500	0.56	0.441	2.33	Air-cooled turbine blades.
Gazelle NG.1 ...	T, a, 6cc, t+t	n.r.	n.r.	1,260	260	20,400	n.r.	n.r.	n.r.	Free-turbine engine for helicopters.
Gazelle NG.4 ...	T, a, 6cc, t+t	n.r.	n.r.	2,000	n.r.	n.r.	n.r.	n.r.	n.r.	Uprated development
Oryx NOr.5 ...	GP, 12a, 5cc, 2t+ aux. comp.	15.3 lb/sec	6.15:1	950 gas h.p. at r.p.m.		22,600	0.62	—	1.9	For helicopter propulsion. Type-tested.
Oryx NOr.10 ...	GP,	n.r.	n.r.	1,250 gas h.p.			n.r.	n.r.	2.3	
RJTV.27	RJ, supersonic	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Work done for N.G.T.E.
Scorpion	R, H_2O_2+Avtur	n.r.	n.a.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Air-fired in Canberra.
Rolls-Royce:										
Avon RA.7R ...	J, 12a, 8cc, 2t, a/b	*130 lb/sec*	*7:1*	n.a.	9,500	7,800	*1.9*	—	3.21	Afterburning unit.
Avon RA.21 ...	J,12a, 8cc, 2t	n.r.	n.r.	n.a.	8,000	7,900	0.925	—	3.17	In service.
Avon RA.25 ...	J, 12a, 8cc, 2t	n.r.	n.r.	n.a.	7,000	7,800	0.91	—	2.87	Civil engine.
Avon RA.14 ...	J, a, ann, t	*160 lb/sec*	*8:1*	n.a.	9,500	7,850	0.84	n.r.	3.32	Redesigned Avon. In service.
Avon RA.26 ...	J, a, ann, t	n.r.	n.r.	n.a.	10,000	n.r.	0.86	n.r.	3.58	
Avon RA.29 ...	J, a, ann, t	n.r.	n.r.	n.a.	10,500	n.r.	n.r.	0.76	n.r.	Commercial-transport engine, high pressure, low temperature.
Conway RCo.5 ...	BP, a+a, ann, t+t	n.r.	n.r.	n.a.	13,000	n.r.	n.r.	n.r.	n.r.	Development unit. Type tested summer 1955.
Conway RCo.10 ...	BP,	n.r.	n.r.	n.a.	15,000+	n.r.	n.r.	n.r.	n.r.	Commercial-transport engine for 1959.
Dart 506	T, 2c, 7cc, 2t	20 lb/sec	5.5:1	1,400	365	14,500	0.727	0.66	1.47	Airline time 1.35m hours.
Dart 510	T,2c, 7cc, 2t	20 lb/sec	5.5:1	1,600	370	14,500	0.689	0.635	1.57	Bulk of current Dart production.
Dart 526	T, 2c, 7cc, 3t	22 lb/sec	6:1	1,910	505	15,000	0.665	0.57	1.88	For Friendship; V.800 engine similar.
Dart RDa.10/2 ...	T, 2c, 7cc, 3t	22+ lb/sec	6+ :1	2,970	500	15,000	0.635	0.56	2.5	Cooled turbine blades.
Derwent 8 ...	J, 1c, 9cc, 1t	63 lb/sec	4:1	n.a.	3,600	14,700	1.05	—	2.8	Over 4½m hours in Meteor.
Griffon 57	P, 12v, liquid	36.7 lit	25 lb/sq in	2,455	—	2,750	—	0.42	1.175	Injection carburettor.
Merlin 724	P, 12c, liquid	27 lit	20.5 lb/sq in	1,760	—	3,000	—	0.45	0.99	Engine-change unit for Argonaut. Two-stage supercharger.
Nene 10	J, 1c, 9cc, 1t	88 lb/sec	4:1	n.a.	5,100	12,500	1.06	—	3.15	Built in G.B. and Canada.
Tyne I	T, a+a, ann, t+t	42 lb/sec	13:1	4,220	1,175	15,250*	0.48	0.41	2.3	Vanguard engine, delivery 1959.
Tyne II	T, a+a, ann, t+t	43 lb/sec	13:1	4,600+	—	15,250*	—	0.385	2.5+	Improved disc cooling; later blade materials.
Tyne III	T, a+a, ann, t+t	n.r.	n.r.	5,000+	—	n.r.	—	0.38	—	Improved h-p. turbine-blade cooling.
Soar RSr.2	J, a, ann, t	n.r.	n.r.	n.a.	1,810	n.r.	1.27	—	6.58	Made by Westinghouse in U.S.A.
RB.106	*J, two-spool*	—	—	n.a.	*15,000+*	—	—	—	—	Unofficially reported. Westinghouse interested.
RB.108	J,	n.r.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	n.r.	Officially announced.

Notes: entries in italics are unofficial but have been published elsewhere; in col 2, P=piston engine, T=turboprop, J=turbojet, BP=by-pass turbojet, GP=gas producer for rotor tip-jets, R=rocket, c=centrifugal compressor, a=axial compressor, a/b=afterburner, cc=combustion chambers, t=turbine stages, ann or cann=annular or cannular combustor r=radial, l=in-line, v=vee-engine, inv.=inverted, Avtur=aviation turbine fuel, H_2O_2=conc. hydrogen peroxide, LO_2=liquid oxygen. All determinations of s.f.c. (specific fuel consumption), and power/wt ratio are based upon static sea-level lb thrust, b.h.p. or total equivalent s.h.p., according to the type of engine considered. *Indicates r.p.m. of low-pressure section. Throughout: n.a.=not applicable; n.r.=not released.



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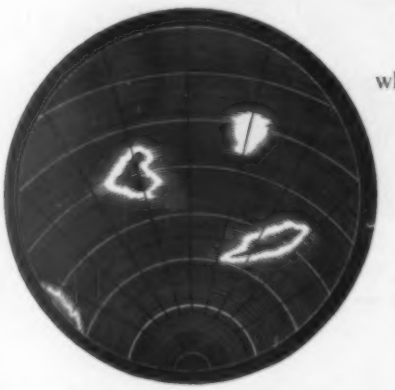
SEEING AHEAD . . . . . .

The growing use of high-speed aircraft has focused attention on the value of Search Radar for weather-avoidance. Already the B.O.A.C. Britannia Fleet is being fitted with EKCO Search Radar, a 3cm equipment which provides early warning of potentially dangerous cloud formations, warning of high ground in the flight path, and map-painting to assist navigation.

With a range of 120 miles, Ekco Search Radar Type E120 incorporates the Iso-Echo Contour facility which delineates the areas of greatest turbulence within the cloud formation. The P.P.I. display shows two contours, one corresponding to the minimum detectable signal level and the other to a pre-determined amplitude above this level.



The P.P.I. display shows a sector of space ahead of the aircraft. Cumulo-nimbus cloud cores are indicated by white areas and particularly turbulent regions by black areas surrounded by white.

Other Ekco equipment, designed in the service of aviation, includes the Airfield Approach Aid which gives 'talk-down' facilities to the smaller airport, multi-channel V.H.F. ground-to-air radio-telephone equipment and the Antenna Pattern Recorder.

SEE US AT
STANDS 273 & 274
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EKCO ELECTRONICS LTD • EKCO WORKS • SOUTHEND-ON-SEA • ESSEX

ACCESSORY DEVELOPMENTS

IT is our custom to review, in this issue, the more complex types of airborne accessories and power-system components developed during the previous year. This never fails to show the ability of the essential, but rarely publicized, associate members of the Society of British Aircraft Constructors to deliver the goods on time.

More than in any previous year, before or since World War 2, the British industry is licence-producing equipment originally developed in the U.S.A. Nevertheless, the traffic flows both ways, and, given the requirement, and the men, money and equipment required to do the job, Britain's accessory firms are the equal of any in the world. This year there will be some three hundred of them exhibiting at their own trade show at Farnborough—a record number—and, in spite of the omnipresent foretellers of recession, cancellation and slump, there is no reason to doubt that the industry will have a satisfactory year.

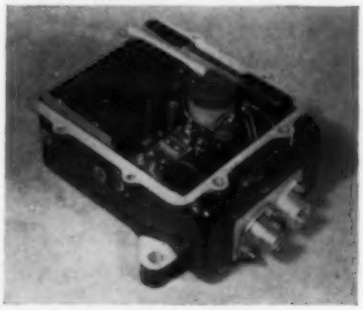
Automotive Products Co., Ltd. From the well-known range of Lockheed-Avery screw-operated self-sealing couplings there has now been developed a super-high-pressure coupling suitable for all aircraft fluids and designed for working pressures up to 5,000 lb/sq in. Bore sizes range from ¼in to ½in. Another type of coupling, which is stated to have been adopted by all British aero-engine manufacturers, is a quick-acting, hermetically-sealing coupling which employs a spring-loaded bayonet locking device capable of being operated simply by hand. A new development of this range has been primarily designed for hydraulic systems, working at up to 4,000 lb/sq in. Full-pressure blanking caps with secondary seals are positioned by the same type of sprung bayonet locks and the couplings will ultimately be available in sizes up to 1in diameter.

Further development has been applied to the familiar range of Purolator filters for oil, fuel and hydraulic fluid. Two types of filter element are produced: the metal-element filter formed from a precision winding of tapered metal ribbon, and the Micronic filter with an element of plastic-impregnated paper.

British Messier, Ltd. One of the most impressive undercarriages yet developed is that for the Bristol Britannia, and for which Messier were entirely responsible. Each main unit has four Dunlop wheels, tyres, hydraulic brakes and Maxaret units. The twin-wheel nose unit is steerable through 50 deg on either side of the neutral position and two air volumes are fitted in the nose leg to accept the considerable pitching action of the long fuselage. A quite different type of undercarriage is that evolved for the Folland Gnat light fighter. Each main leg is of the lateral-suspension type and carries a fairing door which, when the legs are partially lowered, acts as a speed brake.

One of the new responsibilities of the company is the development of the control system for the later Bristol twin-rotor helicopters. These systems govern the cyclic and collective pitches of the rotor blades, with actuation either manually or through an autopilot. Development and production will continue upon all types of hydraulic units for use in airframe systems.

The British Thomson-Houston Co., Ltd. The new liquid monofuel turbo-starter, first revealed last year, is now fully developed, and not only covers the range of all gas turbines in current operation, but also appears suitable for application to the larger turbojets of the future. B.T-H. have long been one of the principal manufacturers of cartridge starters and they have prepared monofuel equipment to replace these with a minimum of modification. Two of the drawbacks of the previous equipment were that it was sometimes very difficult to reach the starter in order to change the cartridges



B.T-H. high-energy ignition unit.

and that, with the steady increase in engine size, such a method of starting is likely to become impracticable. By using the new product, the prime source of energy is a liquid (iso-propyl nitrate) which can be fed to an inaccessible starter position and which can be readily increased in power output to keep pace with future engine designs.

Another line of development concerns high-energy ignition units designed for gas turbines where conditions are such that orthodox booster-coil ignition is unsuitable. Although the electrical discharges are produced at a slower rate than those produced by booster-coil ignition, each charge is of appreciably greater energy. Such units are now available for operation in ambient temperatures up to 150 deg C.

In the field of basic airborne electrical equipment B.T-H. manufacture a wide range of A.C. and D.C. motors specially designed for operating under all conditions of service. The largest machines are employed in flying-control systems and similar services, while very small induction motors are used in radar servo-controls and small blower units.

de Havilland Propellers, Ltd. The major airscrew development is that concerned with the Tyne-Vanguard programme. This unit has four solid light-alloy blades, with a diameter which has now been increased to 14ft 6in. An unprecedented number of new features are incorporated, including: constant-speeding, manual and auto feathering (replacing auto pitch-coarsening), auto synchrophasing, reversing, manual pitch-control or reverse-governing, overspeed and pressure-sensitive mechanical and hydraulic pitch locks, continuous pitch indication and electro-thermal de-icing.

Other airscrews are the 16ft hollow-steel-blade unit for the Britannia and the 16ft 6in unit, of similar construction, now in service on the Beverley. Glass-cloth laminated construction is available on numerous spinners, including those for the Beverley, Herald and feathering Heron.

Using Hamilton-Standard techniques the company are now in full production with cold-air units. These now comprise a widened range, from 20 to 80 lb capacity, and their several applications include the Comet 4. The company are also, of course, a leader in the guided-weapon business.

Delaney Gallay, Ltd. In the latest type of primary-surface gas/air heat exchanger, the construction is entirely of stainless steel giving a very much improved life under arduous operating conditions. Various designs incorporating this type of construction have been specified for some of the latest types of aircraft. In the field of oil coolers, the unit cooled by high-pressure fuel, first exhibited last year, has been found "extremely adaptable to other uses, its construction giving extremely good overall heat-transfer characteristics."

An accompanying photograph illustrates a typical production insulation blanket for a gas-turbine jet pipe. Complete

Delaney Gallay jet-pipe blanket.

insulation is achieved in the latest blankets by virtue of the special construction which gives hermetic sealing and so prevents the ingress of fuel with its attendant fire risk. Gallay also make a variety of equipment for guided weapons, and a new product this year is an all-stainless flushing toilet developed in conjunction with B.E.A. and specified for that operator's long-fuselage Viscounts.

Dowty Group. Principal member of the Group is Dowty Equipment, one of the major undercarriage designing and manufacturing firms. Recent Liquid Spring undercarriage designs include those for the Vulcan (embodying the company's system of controlled articulation), Javelin, Hunter, Sea Hawk and Fokker S.14 Mach-Trainer. The latest Super Vardel 4,000 lb/sq in hydraulic pump incorporates a wave-filter, and the company's electrical division have evolved an electronic tachometer and high-speed counter suitable for application to gas turbines.

Dowty Seals, Ltd., are now in production with a wide variety of seals employing natural, synthetic and silicone rubber sealing media. Specialized items include several patented types of leak-proof

ACCESSORY DEVELOPMENTS . . .

washers, lock washers and bolts. Dowty Fuel Systems supply complete fuel systems for gas turbines, using spill burners and, in the latest installations, a single-circuit system.

Dunlop Rubber Co., Ltd. At the time of going to press details of the latest developments were not available. The company are, however, one of the largest suppliers of aircraft tyres—now frequently of the tubeless variety—and also manufacture a wide range of other equipment, including complete brake systems and Maxaret anti-skid units. Other very important production items include pneumatic-system components for aircraft, engines and guided weapons, windscreen wipers, glass-fibre air-storage bottles and various types of armament equipment.

Flexible pipes are available catering for the requirements of low-, medium- and high-pressure (up to 6,000 lb/sq in) systems. Electro-thermal anti-icing installations, fitted with automatic control, are used on several modern aircraft, and Dunlop, with the associate firm of Xetal, Ltd., make all kinds of components in natural and synthetic (including silicone) rubber and other material.

Electro-Hydraulics, Ltd. The difficulty of accommodating undercarriage units inside high-performance aircraft is increasing year by year. One of the most unusual, and most elegant, solutions is seen on the English Electric P.1 fighter, in which the main legs are hinged in the geometric centre of each mainplane and fold outwards and the nose unit retracts forwards, the wheel turning to lie flat. In the much larger Victor the company nevertheless had to exercise great ingenuity in evolving a system capable of putting an eight-tyre bogie unit inside each wing. This year one of the systems developed provides for the retraction of the main legs into the fuselage of a high-speed machine. This is achieved by employing a unique geometry.

Production is in full swing upon gear for such aircraft as the Shackleton, Pembroke and President, and for the Herald. For the latter aircraft Electro-Hydraulics also supply virtually the whole hydraulic system. The company make various hydraulic components such as swivel connections, pressure switches and hydraulic jacks; a typical example of the latter is the ram which actuates camera doors on the Swift F.R.5.

The English Electric Co., Ltd. Emphasis is now being laid on alternating-current aircraft electrical systems, with a view to the development of completely paralleled generation and distribution. As a pre-requisite to the latter the company are continuing development of, and are in production with, the Sundstrand variable-ratio hydraulic drive.

One of the most important standard ratings for such drives is 40 kVA, and this is associated with the Type A.E.918 alternator, of the same rating. Other new products, which have not previously been revealed, are a 28-kVA alternator, a transformer/rectifier designed to provide 28-V direct-current from an A.C. system, a panel for the control and protection of a 40-kVA alternator and a 12-kW starter/generator which develops 10 h.p. as a motor. Production is spread over a wide range of A.C. and D.C. machines, the smallest being 1in in diameter.

Among the wide range of linear and rotary actuators for airborne applications are three new types. Two are "universal" linear and rotary, respectively, and the third is the type AE.237 rotary actuator

Ferranti F.H.5 (Mk 4) horizon.

designed for the high-speed operation of fuel cocks; it is designed for an operating load of 20 lb-in and a full-stroke time of only 0.2 sec.

Ferranti, Ltd. Among their vast range of products this company produces many items of airborne equipment. Technically some of the most absorbing work is connected with "weapons systems" but little of this has so far been made public. Simpler types of armament equipment include two modern gunsight installations. The G.G.S. Mk 8 is an improvement on the familiar gyro sight, with servo-controlled ranging capable of use with radar. The Light Fighter sight comprises a miniature sighting head and a switch unit, the whole installation scaling but 7 lb. It can be used for guns or rockets and an additional control unit is available for incorporating radar ranging.

New instruments include the F.H.7 (miniature) horizon, using the "pitch-bank" erection system for simple gyro verticals, and the F.H.5 (Mk 4) horizon with automatic levelling. The latter is used at start-up to relieve the pilot from having to use the fast-erection push and also to remove any possibility of take off

Flight Refuelling Mk 32 valve.

with the horizon on a false datum. A further development of the F.H.5 is the F.H.6 (Type C) instrument, with a boosted gyro run-up and auto-levelling, in a sealed case.

Flight Refuelling, Ltd. This company are now able to provide a complete range of components for fitting in all parts of aircraft fuel systems. Two new in-line components this year are the Mk 29 refuelling/defuelling valve and the Mk 32 double-refuelling valve illustrated.

The Mk 29 is designed specifically for installation in a combined engine-feed and pressure-refuelling line, and combines the following features: solenoid refuelling control for selective on-loading; sense-line control to give automatic, non-selective, off-loading action; and control of the off-loading side by a remote float unit which closes the valve at a predetermined low fuel level and thus prevents air from entering the fuel line. The Mk 32 refuelling valve is an electrically-operated, double shut-off unit, designed for tank mounting and incorporating two valves in series controlled independently by separate float-operated solenoids. In the event of electrical failure the valve automatically fails shut, and the double shut-off feature gives an added safety factor where structural design prevents adequate venting.

Owing to the size of the units involved, probe-and-drogue flight-refuelling equipment can best be demonstrated in the form of working models. One of the new developments in this field is an external pod dispenser similar to that designed by the associate firm of Flight Refueling, Inc., in the U.S.A. for the North American F-100. The unit is completely self-contained and is designed for mounting as a standard under-wing store.

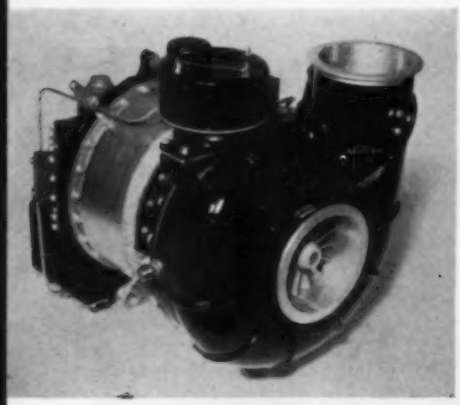
Girling, Ltd. First revealed last year, development has gone ahead rapidly on various types of hydraulic anti-oscillation dampers for aircraft flying-control systems. Damping problems in such systems are becoming progressively more important as flight speeds rise and powered controls are increasingly resorted to.

To limit the control-system disturbances caused by turbulence, and hence restrict the pitching and yawing resulting from manual over-correction, Girling have developed a range of self-contained units for location either at the surface or wherever damping may be required. These damping units obviate the need for heavy and complicated operating linkages. Resistance characteristics are generally based on orifice control, a thermostat being incorporated to limit the effects of viscosity change over a range of ambient

Girling aileron control damper.

temperature from −60 to +80 deg C. Prototype dampers are often provided with quick manual adjustments with which the optimum setting for the production unit can be determined.

The company have also continued development of disc brakes. Girling aircraft products in this field employ single or twin discs floating on axial splines. When the unit is energized, the disc is gripped by friction pads of the segmental type mounted in either a single caliper or diametrically opposed calipers set astride the disc. The production units incorporate provisions for easy servicing, automatic take-up of wear, operation by a hydraulic or pneumatic system and with separate emergency operation.



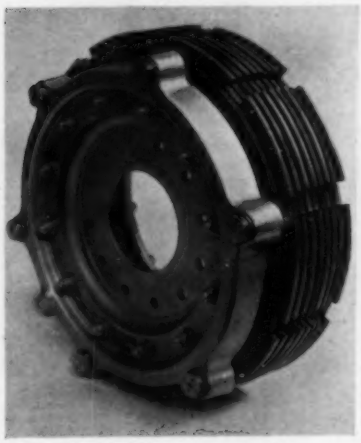
Godfrey TA-15 turbo-alternator.

Sir George Godfrey and Partners, Ltd. Since World War 2 a considerable expansion and general broadening of scope have taken place in the spheres of aircraft pneumatics and air-turbine-driven electrical generating equipment. During the past year a technical exchange agreement has been negotiated with the Stratos Division of the Fairchild Airplane and Engine Corporation. A licence has also been acquired from Svenska Rotor Maskiner, A. B., to manufacture the familiar S.R.M. compressor; the S.R.M. principle is, in fact, employed in cabin superchargers and Freon pumps now under development, one of which is the new Type 175. One of the advantages of the Godfrey/S.R.M. screw-type rotor system is that, as well as being of a positive-displacement nature, it also has a built-in pressure ratio.

Two new products operating on the Roots principle are the PA-100 actuator and Type 5 supercharger. The latter, an experimental machine, has a pressure ratio of 1.2/1.5:1 and weighs only 8½ lb; it may be used as a pneumatic booster, air motor or supercharger. New valves include the CV-1, applied to ventilated-suit systems to maintain constant flow and pressure at the suit inlet; the CV-18, for complete air-conditioning systems; and the PRC-4, a pressure-ratio controller for cold-air units operated by a capsule and providing almost instantaneous correction with complete freedom from hunting. Another new development is the ventilated-suit cooling package comprising a primary heat exchanger, a brake-turbine cold-air unit, the exhaust from which cools a secondary heat exchanger, and a water separator. The cooling flows run in parallel, one supply ventilating the suits and the other cooling the ventilating air. Equipment for Freon cooling systems includes the DP-5, developed from a special air pump, and the TFC-1 energized by an air turbine.

A photograph shows the TA-15 turbo-alternator rated at 15 kVA. First referred to last year, the unit is now fully developed, and a particularly interesting feature is the air/fuel heat exchanger which cools the alternator. Progress is also being made in the design, development and manufacture of miniature turbo-alternators, alternator-control gear, radar-cooling units, ground-conditioning trolleys and equipment for cooling and handling missiles.

Goodyear Tyre and Rubber Co., Ltd. The engineers at Wallasey have now perfected an electro-mechanical anti-skid brake device, based on a previous all-electric unit. Mounted in each wheel it brake, which is already in production at Wallasey for the DC-7C, and is projected for Viscount 800s and Vanguards. The moving discs are faced with a coating of special sintered iron and the fixed discs are of a steel which, being incompatible with the sintered coating, cannot fuse with it in service. The Tri-Metallic brake has other advantages: size-for-size it can accommodate more discs (these being only about 3/16in thick) and so can have a greatly increased friction area and torque capacity; and, as the assembly is all-metal, the whole mass provides the heat sink.



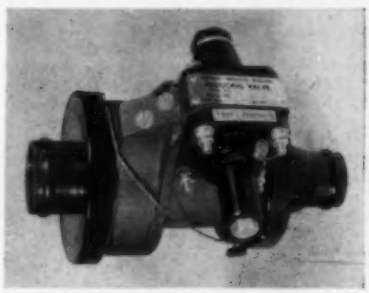
Goodyear Tri-Metallic brake.

H. M. Hobson, Ltd. Many types of powered flying control are now in production or under development for the majority of the latest British high-speed aircraft. The Type 251 control incorporates electrical (as distinct from mechanical) linkage between the cockpit and the powered system and parallel triplication is employed to guard against electrical failure. Advantages claimed are a saving in weight and an improvement in stiffness, performance and general handling. Furthermore, development can be completed without having to consider structural feed-back.

The powered control Type 163 Mk 4 (which actuates the tailplane of an all-weather fighter) embodies a high-efficiency screw-jack powered by duplicated hydraulic motors and supply systems, either of which can effect proper operation. An accompanying photograph shows the Type 149 Mk 2 control which operates the rudder of a heavy bomber. Here again full duplication is provided and an integrated destabilizer actuator superimposes de-control functions on the pilot's commands. Hobson also manufacture many types of autopilot-powered control and servo-actuator, together with various feel-simulator units.

Among the several types of fuel-control unit for which Hobson are responsible is the Type 268, which is a hybrid scheduling and speed-governing system. It incorporates a gear-type starting pump; a main centrifugal pump with circulating impeller; flow and accelerator controls; and a speed governor. Another type of speed-governing unit is the Type 100, which controls the fuel supply to the turbojet fitted to a pilotless aircraft. Hobson also make many types of ramjet control unit, one of which, the Type 176, automatically controls the fuel supply in a pilotless ramjet vehicle according to the mass airflow passing through the engine. The profiled metering valve is positioned by a pressure-sensitive capsule and a regulating valve controls the pressure-drop across the metering orifice.

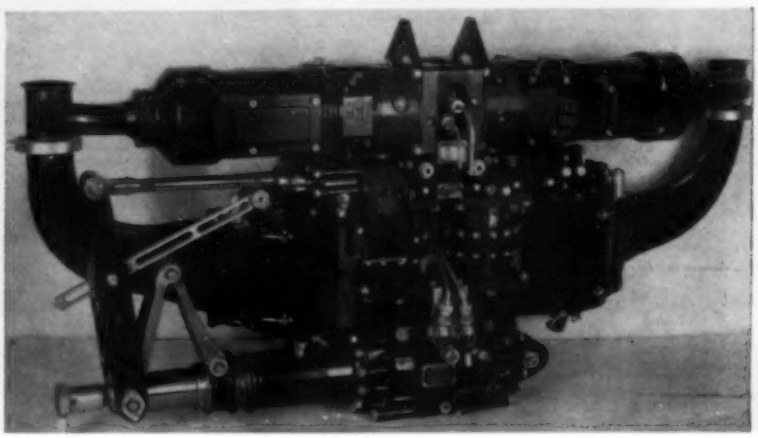
The Hymatic Engineering Co., Ltd. One of the latest additions to the company's wide range of airborne electro-pneumatic valves is the MD.23. It is designed as a stop valve for pneumatic or gas systems and the control of air supplies to guided weapons. It is exceedingly flexible and can operate at working pressures between 100 and 4,000 lb/sq in; and, notwithstanding the latter value, the weight has been kept down to 1.8 lb. It is rated at the low current drain of 0.16 amp at 24 V.



Hymatic PS.81 reducing valve.

An accompanying photograph shows the PS.81 reducing valve which, for a weight of 2.35 lb, accepts a flow of 15 lb/min at an inlet pressure of 12-15 lb/sq in and delivers an output giving 8±0.1 lb/sq in. Other new products include the PS.64/1 reducing valve, which takes 3,000 lb/sq in

Hobson Type 149 Mk 2 powered flying control.



ACCESSORY DEVELOPMENTS . . .

and delivers at a pressure of 10±3in of water up to a free-atmosphere flow of 90 cu ft/min, and the SV.17/1 stop valve in which an electrically-fired fuse destroys the support for a disc of light-alloy foil which thereupon bursts under stored gas pressure.

Integral, Ltd. An accompanying photograph of the hydraulic motor/pump unit Type 215 Mk 2 reveals the motor (input, 3.1 gal/min at 1,500 lb/sq in) and, at the other end of the same 6,000 r.p.m. shaft, the pump delivering 1 gal/min at 3,600 lb/sq in. The unit provides emergency hydraulics; the pressure-feed to the motor is obtained from the powered flying-control system supply and the pump is fed from an emergency reservoir. The output of the pump is varied inversely with its

Integral Type 215 Mk 2 unit.

delivery pressure by throttling the feed to the motor until the unit finally comes to rest at maximum line pressure. The unit also has applications as a pressure-intensifier. Another new motor/pump unit is the Type 213 Mk 1, driven by a 24-V D.C. motor and providing 6.6 to 7.5 gal/min at 5,000 r.p.m. This unit replaces a gear-type pump—weighing almost four times as much—in the Westland Whirlwind, where it supplies low-pressure fluid to the transmission system in the rotor drive.

Two new hydraulic pumps are Types 167 and 230. The latter is one of the first British variable-stroke units, with a servo-controlled hinged swash-plate drive, an initial gear stage and inbuilt relief, suitable for operation at up to 10,000 r.p.m. At 8,000 r.p.m. it can deliver 20 gal/min at 4,000 lb/sq in and the weight is 24 lb. An even larger pump is the Type 65W.1001, designed by the New York Air Brake Co.; it is a fixed-swash-plate unit delivering up to 26 gal/min.

Work is also going ahead on several other types of hydraulic mechanism, and on the complete Faure-Herman electronic fuel flowmeter system.

Kelvin and Hughes, Ltd. Owing to the need to conserve panel space the well-known indicating accelerometer, standardized on R.A.F. fighters, has been miniaturized. As on the larger instrument, magnetic damping is effected by a copper-alloy drum rotating within an air gap between a permanent magnet and keeper. Another miniaturized instrument is a turn-and-slip indicator which now fits a 2¼in case.

In order to provide a single unit performing the function of two separate switches, a range of double-ratio Mach switches is now available. A typical application is the automatic operation of speed brakes, in which the two sets of switch contacts are arranged to extend the surfaces at one Mach number and shut them at another, thereby obviating the danger

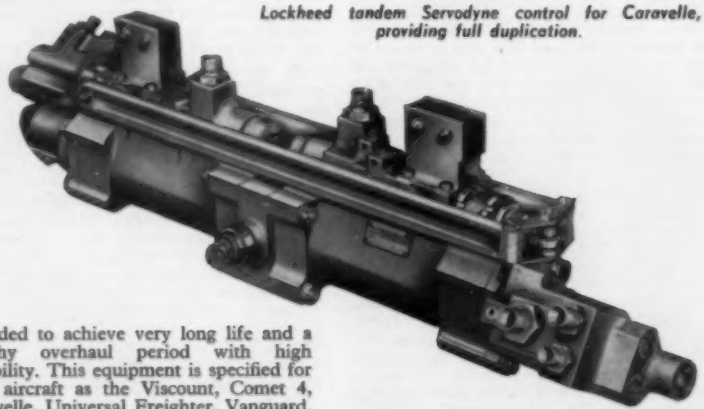
Kelvin Hughes altimeter.

of hunting. Versions can also be provided operating at either a given airspeed or a given Mach number, whichever is the lower in terms of i.a.s.

K.L.G. Sparking Plugs, Ltd. In the field of harness equipment a new development is a special low-tension system for a Bristol engine. This harness, which contains the wiring for all the low-tension engine services, is fabricated from stainless-steel tube and is arranged in handed port and starboard sections. The range of sparking plugs and ignition plugs for all kinds of powerplant increases in scope week-by-week, and one of the new lines of development is a radical departure from conventional elbow insulation techniques. The new elbow is lined with a thin wall of ceramic material bonded over the interior surfaces. The technique permits a lower overall height and a neater assembly of the high-energy igniter, to which it may be permanently attached.

Lockheed Hydraulic Brake Co., Ltd. Work is now concentrated on hydraulic equipment—including complete systems

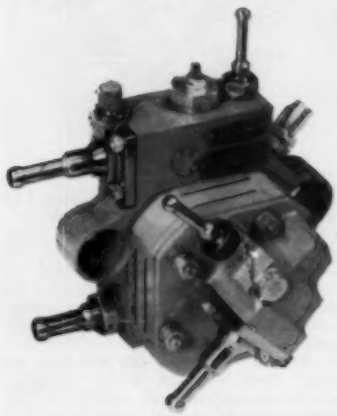
Lockheed tandem Servodyne control for Caravelle, providing full duplication.



intended to achieve very long life and a lengthy overhaul period with high reliability. This equipment is specified for such aircraft as the Viscount, Comet 4, Caravelle, Universal Freighter, Vanguard, Herald, Accountant and Twin Pioneer. During the past 12 years considerable experience has been gained with the Servodyne type of powered flying-control system and an accompanying illustration depicts the tandem-built Servodyne which provides f lly duplicated power for the flying controls of the Caravelle.

Joseph Lucas (G.T.E.), Ltd. One of the world's largest and most important manufacturers of aircraft fuel-system and combustion equipment, Lucas are keeping ahead of a rapidly developing and competitive business. Fuel pumps of the plunger type are available in capacities from 438 to 2,600 gal/hr at a maximum delivery pressure of 2,000 lb/sq in; the small units are rated at 4,000 r.p.m. and the larger pumps at 3,000 r.p.m. A variety of booster pumps are also in production driven by both air turbines and electric motors.

Electrically-driven booster pumps have not yet been exhibited. There are three basic types each comprising a high-speed, single-stage centrifugal impeller driven by a submersible motor. Alternative motors of various A.C. and D.C. voltages, and a



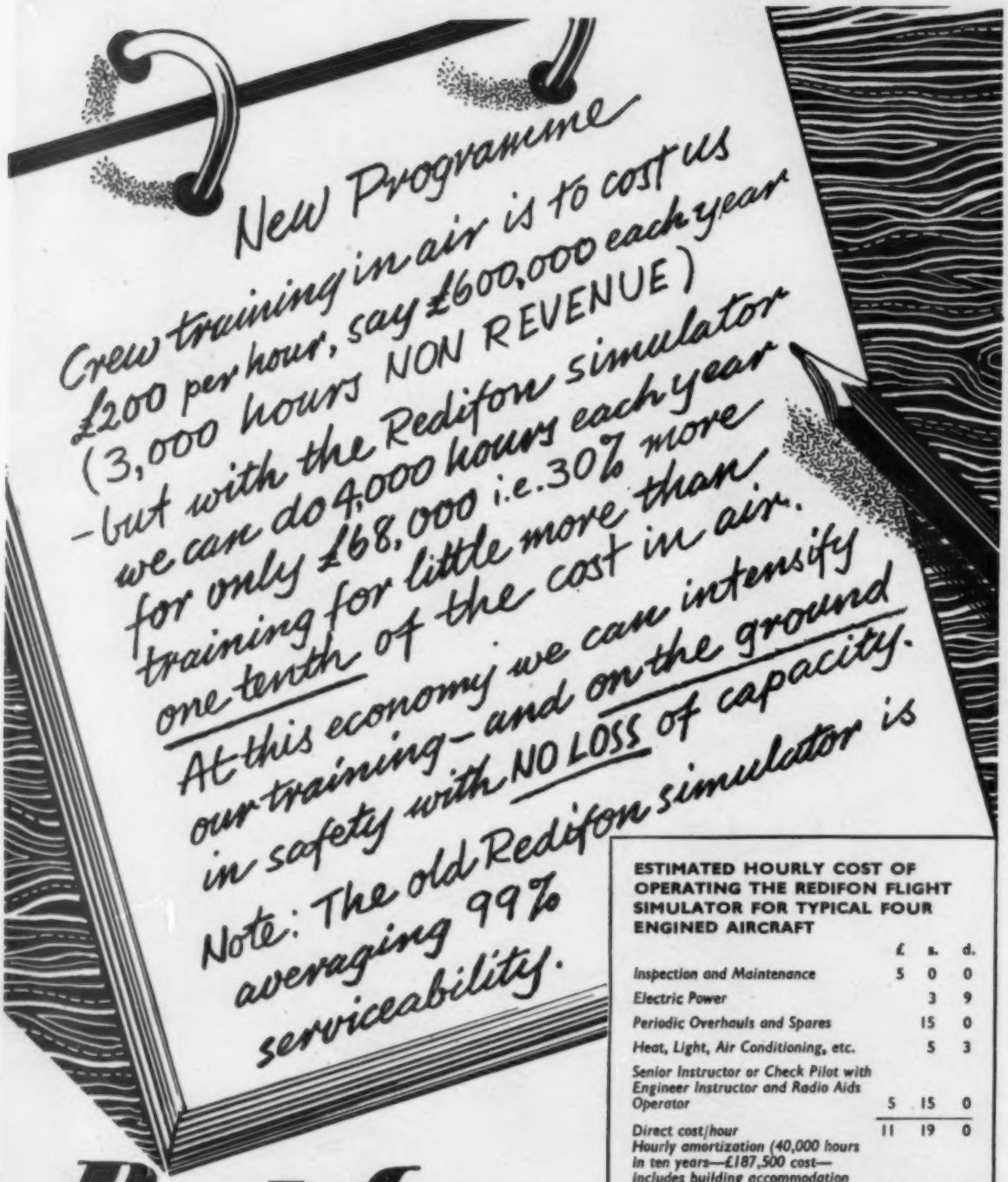
Lucas ramjet Mach control.

choice of side or bottom tank mounting, makes possible a very varied range of units delivering from 800 to 2,000 gal/hr at a design speed of 5,500 r.p.m. A larger type of booster pump is driven at 12,000 r.p.m. by a turbine running on compressor-bleed air, and provides a flow of no less than 6,500 gal/hr. In general, Lucas pumps are designed to operate at fuel temperatures from −45 to +50 deg C at altitudes up to 60,000ft, the tanks being pressurized at 3½ lb/sq in. At least one type of turbo-pump has successfully passed a 500-hr type test.

The company have recently assembled a display consisting of the actual fuel system taken from a Dart turboprop from a B.E.A. Viscount. The components have successfully completed 1,600 hours' continuous operation and are scheduled for another 500 hr before major overhaul.

A new departure is the development of

IROQUOIS,
Orenda's supersonic turbojet, has passed
its fifty hour flight rating test—
successfully, and on schedule.
ORENDA
ENGINES LIMITED
MALTON, CANADA
MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP



New Programme

Crew training in air is to cost us £200 per hour, say £600,000 each year (3,000 hours NON REVENUE) – but with the Redifon simulator we can do 4,000 hours each year for only £68,000 i.e. 30% more training for little more than one tenth of the cost in air.

At this economy we can intensify our training – and on the ground in safety with NO LOSS of capacity.

Note: The old Redifon simulator is averaging 99% serviceability.

ESTIMATED HOURLY COST OF OPERATING THE REDIFON FLIGHT SIMULATOR FOR TYPICAL FOUR ENGINED AIRCRAFT

	£	s.	d.
Inspection and Maintenance	5	0	0
Electric Power		3	9
Periodic Overhauls and Spares		15	0
Heat, Light, Air Conditioning, etc.		5	3
Senior Instructor or Check Pilot with Engineer Instructor and Radio Aids Operator	5	15	0
Direct cost/hour	11	19	0
Hourly amortization (40,000 hours in ten years—£187,500 cost—includes building accommodation and installation)	4	13	9
Simulator cost/hour	£16	12	9

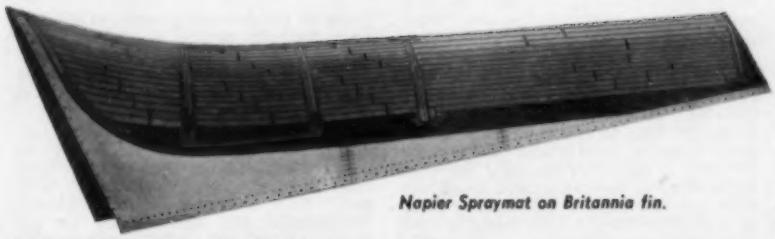
Redifon

FLIGHT SIMULATORS

Flight Simulator Division

REDIFON LIMITED · CRAWLEY · SUSSEX

A Manufacturing Company in the Rediffusion Group



Napier Spraymat on Britannia fin.

ACCESSORY DEVELOPMENTS . . .

hydraulic equipment, in the form of a D-size hydraulic pump (evolved from the well-known fuel pump) which can be coupled to a Lucas hydraulic motor and 3-kW generator. Using D.T.D.585, the D-size hydraulic pump can deliver 18 gal/hr at 3,000 lb/sq in, for a weight of 24 lb. The range of hydraulic motors operate at up to 2,500 lb/sq in at from 3,000 to 8,000 r.p.m. requiring from 40 to 1,000 gal/hr per thousand r.p.m. Eventual pressures of 5,000 lb/sq in are envisaged.

Other lines of development include the inert gas generator system for purging fuel tanks, an assortment of space heaters up to 4 therm/hr, and all types of combustion chambers and heat exchangers. Although nothing can be said of their applications, units which feature in ramjet systems include a Pintle burner and a Mach-number control. The latter unit is illustrated on the previous page.

Marston Excelsior, Ltd. A subsidiary of I.C.I., this company have now produced a new and improved flexible fuel tank to supplement the well-known "Flexelite" range. Known by the name "Marlite" the new tanks are stated to be "considerably lighter than any tank of British manufacture hitherto available to the aircraft industry." The weight is 1.4 oz/sq ft and the material is much more resistant to cuts and abrasions and is fully ozone-resistant. A.R.B. approval has been granted.

Other activities include light-alloy heat exchangers for both military and commercial aircraft and a variety of products in reinforced plastics, including radomes, fin tips, aerial housings and drop tanks. Light-alloy tanks are also made, principally for Sabres.

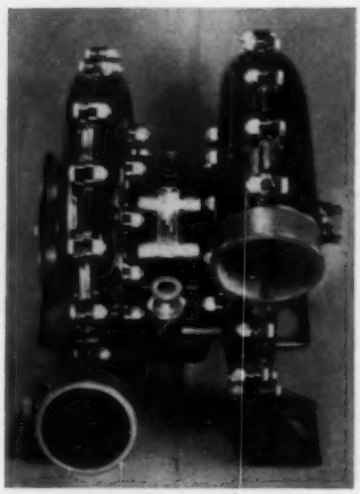
D. Napier and Son, Ltd. The "Spraymat" de-icing system is now widely employed on several production aircraft. It consists of sprayed-on electric elements embedded in insulation compound, and can readily be applied to the most complex surface profiles.

A considerable quantity of "Spraymat" is used on the Britannia, and a photograph shows the method of de-icing the fin of this aircraft. Of the total of 140 sq ft applied to the empennage the fin accounts for 32.5, which receives electric heating at the rate of seven to 13 watts per square inch on a cyclic basis (the load for the whole tail is 20.4 kW). Kumanal sprayed elements are used, embedded in Type 2 insulation, the latter being cured at reduced temperature to make the assembly suitable for attachment to Redux-bonded structures.

Current Spraymat developments are aimed at evolving the best possible forms of protection capable of resisting extremes of temperature, rain and other types of erosion, and fatigue.

Normalair, Ltd. During the past twelve months several new activities have rapidly come to occupy major positions. One of these is Freon cooling of cabin air, a method long used in the U.S.A. Normalair are one of the first firms to bring the system to Europe and are offering a 12-ton range of equipment including a compressor which can be driven either electrically or by a bleed-air turbine. The company are also advancing on a broad front in the evolution of oxygen systems, and have developed a new lightweight portable set for civil aircraft and a system based on the original Bendix liquid-oxygen converter.

Another new development is a system for the automatic control of air supply, temperature, pressure and humidity in circuits serving air-ventilated suits. Associated with this equipment is the latest form of demand regulator for use with pressure garments, fed from a liquid-oxygen converter. Other new components include a water extractor, which retains the water condensed by a cooling turbine, and the venturi humidifier supplied for



Normalair 70 lb bootstrap turbine.

Britannias and Heralds and specified for later Comets.

A photograph depicts one of the largest of the Normalair cooling turbines. The 10, 18 and 25 lb units are air-turbine-driven fans; the 50 lb unit embodies a turbine-driven compressor which acts as a jet pump to induce a greater flow through the upstream heat exchanger, and the 55 and 70 lb units can operate on the familiar bootstrap principle. Owing to their very high rotational speed these assemblies are of an exceptionally low weight for their output.

The Palmer Tyre, Ltd. This company are in a strong position in the supply of complete wheel and brake assemblies for various types of smaller aircraft and helicopters. Among the latter, Palmer are responsible for complete assemblies for the Bristol 192 series of twin-rotor machines. There are also two new designs of wheel and brake units for fixed-wing aircraft.

One of these was originally designed for the Jet Provost T.2. The brake is of the disc type, with two diametrically opposed pistons which leave the greater part of the disc exposed to ensure rapid cooling—very necessary during most training operations. Other features of the system are a pressurized reservoir, parking control and thermal-overload compensators which maintain parking pressure and also relieve the brake lines at a pressure below that at which skidding might occur. In the Jet Provost the system is arranged for dual control.

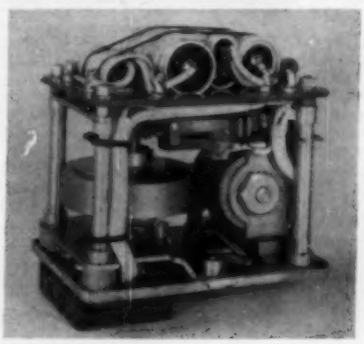
The other new assembly is suitable for use on light aircraft up to a weight of some 3,750 lb. It also incorporates a disc brake, but in this case an annular piston is used; it is designed to offer private owners an effective and relatively inexpensive braking system meeting modern requirements.

Work is also going ahead on various pneumatic and hydraulic control units and reducing valves, the Palmer X-Ray Inspection Service and the widely used "Silvoflex" hosing. Of the latter the Silvoflex Type 200 high-pressure hose is worthy of note, used for fuel, oil, hydraulic and other fluids over wide ranges of pressure and temperature, and with special maximum-flow, vibration-resistant end-fittings. This hosing is now used in many high-performance aircraft and missiles.

The Plessey Co., Ltd. One of the principal new developments this year is the company's first ram-air turbine, developed as an emergency source of power for maintaining essential services following engine or component failure. Known as the TRA 150/2, the turbine incorporates an in-built speed control which limits the rotor speed and allows satisfactory operation under all conditions up to sonic speed at sea level. As a hydraulic unit, incorporating a Plessey pump, the output is 3½ hydraulic horsepower at any speed over 150 kt i.a.s. Units of this type weigh approximately 18 lb and are due to be installed as standard equipment in several new aircraft. Various types of installation have been prepared; in some of these the unit can be swung out into the airstream by automatic or manual means, while in others the equipment is housed permanently within the airframe, the air being taken in through suitable ducting. Alternatively the turbine can be readily adapted to drive an alternator or D.C. generator.

A new design of high-temperature plug and socket has been cleared for use at temperatures up to 400 deg C. The assembly is fully pressurized and an unusual technique employed in the construction of this component is the brazing

Plessey inertia flasher unit.



ACCESSORY DEVELOPMENTS . . .

of the inserts directly into the ceramic insulation. The company are also in production with flasher units (picture on p. 401) controlling aircraft navigation lights, employing inertia timing. These are now effective under operational conditions up to 60,000ft and between temperature limits of from −65 to +75 deg C under acceleration loadings of up to 11 g in any direction.

Power Auxiliaries, Ltd., a company of the Plessey Group, are now in receipt of large contracts for the new Plessiflex fire-resisting, seamless, flexible hose. Manufactured in stainless steel, bronze, brass and Monel, Plessiflex operates efficiently under extremes of temperature, flow pulsation and constant pressure and vibration. It is available over a range of internal diameter from $\frac{1}{16}$in to 2in.

The Pulsometer Engineering Co., Ltd. Virtually all types of tank-mounted booster fuel pumps are now being manufactured, and particular emphasis is being placed on double-ended and air-turbine-driven assemblies. One of the latter is rated at some 60 h.p., but details are restricted; other turbine driven pumps are the PAT.3500 Mk 1 (3,500 gal/hr) and 2,500 (2,500 gal/hr), both designed for bottom mounting. A particularly interesting development is the Type PHD.4500 DE, a double-ended pump rated at no less than 4,500 gal/hr and driven by a 1,350 lb/sq in hydraulic motor.

A demonstration rig has been made showing a PDC.2400 DE pump mounted on the bottom of a rotating tank. The rig can operate inverted at the rated output of 2,400 gal/hr, the drive being from a 26-V D.C. motor. Other models of pump are rated at from 50 to 2,760 gal/hr, and one unit, Type PAC.1209, is driven by a 200-V, 400 c.p.s. three-phase, squirrel-cage motor.

Rotax, Ltd. During the past twelve months the company have continued intensive development of turbo-alternators to supply constant-frequency A.C. power. As a result they can offer integral sets rated at 15 and 30 kVA, and the design of a 60 kVA unit is now complete. Also available is an air-turbine drive, including gearbox, which is suitable for use with an already widely used 30-kVA, 400 c.p.s., 8,000 r.p.m. alternator. Other work is going ahead upon voltage- and frequency-control systems, protection units and control switch-gear for use in complete constant-frequency systems.

In conjunction with the above, development is proceeding upon all forms of high-efficiency, fixed-frequency A.C. motors and actuators. Two such items are the CA.1201 motor and CA.1101 rotary actuator. The former is rated at 1 h.p. at 2,520 r.p.m., or at a peak of 6 h.p. for 1½ min: it has been designed for such applications as power-operated flying controls and will operate satisfactorily at up to 60,000ft. The CA.1101 comprises two reversible motors driving a differential gearbox coupled to twin output drives turning at 324 r.p.m. with a rated torque of 150 lb-ft. The total weight is 100 lb.

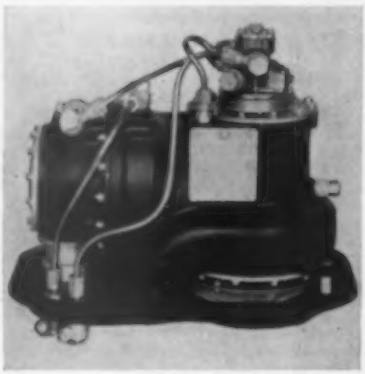
New additions to the D.C. machinery include the 5.4-h.p. C.10101 weighing 31 lb, and the 15-h.p. EXP.5024 weighing 57 lb. New light-weight, high-speed generators rated at 3.5 kW have been developed for use in 28-V D.C. systems. Cooled by ram air and capable of operation at 50,000ft, these generators are continuously rated at any load up to 120 amp over a speed range from 8,750 to 13,100 r.p.m. The subject of an accompanying illustration is a new rotary transformer which steps down 112-V current to 28 V; when used in conjunction with a starter panel and voltage regulator, the continuous output can be 3 kW for an input current of 38.5 amp. The weight is 49 lb. Other new electrical equipment includes the S.3302 inverter which delivers 250 VA of 115-V, single-phase, 400 c.p.s. current from a supply of 28-V D.C., and two new types of three-phase current-balance unit which put any supply line on open-circuit should the current fall below a specified limit.

Parallel to the introduction of fuel/air starting systems in 1954, Rotax also introduced the CT.0801 light-weight, low-cost, pneumatic starter. These units are already installed on Orpheus turbojets and the company have now developed new systems for multi-engined aircraft. One system for twin-engined machines employs a combination of fuel/air and pneumatic starters, thus improving the overall power/weight ratio. The first engine is started by the fuel/air unit and its compressor is then bled to energize the pneumatic starter on the second engine. The utility and weight-saving of such an arrangement are self-evident.

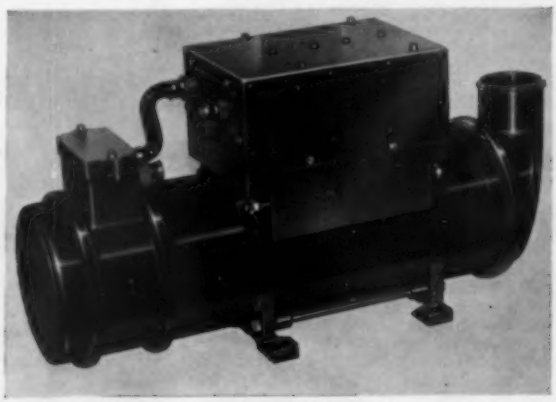
Rotol, Ltd. One of the major production items in the field of airscrews is the four-blade, 10ft-diameter unit used on the later types of long-fuselage Viscount transport aircraft. Operation is hydraulic, with three oil lines and a fixed cylinder; the blades operate from the starting pitch of 0 deg to the feathering angle of 84 deg. Each blade is of the square-tip, high-activity type and is provided with electrically-heated elements rebated in the leading edge. Additional de-icing elements are built into the nose of the spinner.

For some years Rotol have been producing air-turbine motors running on compressor bleed air. These motors have been built in several forms, both with direct drive and attached to a gearbox. Applications will also shortly be announced for the company's ram-air turbine, which is unusual in having variable-pitch blades automatically governed to prevent overspeeding. The turbine has a single stage of ten blades and is directly coupled to an emergency hydraulic pump for energizing the power-control system in the event of engine failure. The diameter of the unit is 12in and the weight 18 lb.

Fuel-flow proportioners are now available with a powered drive, enabling them to impart a not inconsiderable pressure rise as the fuel passes through the cells. Rotol continue to be the principal supplier of accessory gearboxes, and one recent box—for an aircraft powered by twin Sapphire turbojets—has recently been completely sectioned. One of the major loads transmitted by this box takes the form of a pair of large generators and, through a system of free-wheel drives, power is transmitted from whichever engine happens to be turning the faster.



(Left) Pulsometer PAT. 3500 pump.



(Right) Rotax 3 kW, 28-V rotary transformer.

Saunders Valve Co., Ltd. With the principle of diaphragm-sealing now generally accepted, the latest production valves embody detail refinements. New models are now in production.

A photograph depicts a new high-pressure axial-flow valve. It has been designed

Saunders h.p. axial-flow valve.

to handle fuels, oils, nitrogen or air at working pressures up to 4,000 lb/sq in (proof loading, 9,000 lb/sq in); it is available with manual or electric operation for the 180-deg control movement (maximum torque, 301 lb-in) and is made in sizes from ¼in to ⅜in, the ½in size weighing 1.85 lb. Other new products are a high-pressure spherical plug valve (for 2,000 lb/sq in working pressure, weighing 0.99 lb in ¼in bore size) and a hot-air non-return valve, one version of which has aluminium-alloy end connections and stainless-steel internal components, and can operate at 300 deg C at 120 lb/sq in, and a second all-stainless version designed for 500 deg C at 200 lb/sq in.

Self-Priming Pump and Engineering Co., Ltd. One of the new accessories illustrated in these pages is an example from the range of S.P.E. air-turbine-driven fuel-booster pumps. Such pumps are now firmly established in the latest types of aircraft and, compared with electrically driven units, are relatively light and compact. One of the largest of these units is rated at 3,500 gal/hr at 11 lb/sq in, having

S.P.E. turbo fuel-booster pump.

a two-stage impeller and a two-stage turbine.

Other standard submerged booster pumps are the Types 803 and 1203 (24 volts) and 806 and 1206 (112 volts). The 803 and 806 are each rated at 800 gal/hr on kerosine, at 11 lb/sq in, for a current consumption of 12 and 2.5 amp, respectively. Both pumps weigh 15.5 lb. The larger units deliver up to 1,200 gal/hr at the same pressure, consuming 15 and 3.25 amp, respectively, and weighing 16.25 lb. All the electrically driven pumps are provided with radio suppression.

Serck Radiators, Ltd. A comprehensive range of aircraft heat-exchanger equipment is now in production. One of the major lines of development concerns light-alloy oil coolers for advanced turbojets, cooled by high-pressure fuel. Fuel at lower pressures is also employed in light-alloy coolers associated with the bearing-oil systems for helicopter rotor heads.

Radial-flow oil coolers are in production in sizes from 5in to 14in diameter for engine, reduction gear and other oil circuits on turboprops and piston engines. The range of radial-flow oil coolers also includes units for helicopter applications, fitted with electrically-actuated shutters to regulate the air flow. Serck also manufacture matrices for fuel-filter de-icing.

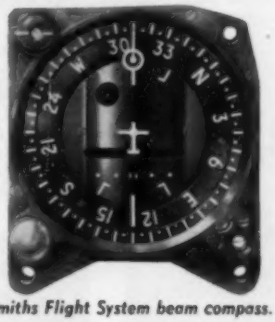
Short Bros. and Harland, Ltd. The company's Precision Engineering division have now reached an advanced stage in the development of advanced aircraft control systems—which possibly has a bearing on the forthcoming P.D.11 experimental aircraft. A new demonstration rig comprises a hydraulic power control coupled to the Short analogue computor and a servo-controlled two-axis rocking table. The input (pilot stick movement) for the elevator is fed into the control system and the resulting surface movement is passed to the computor which solves the aerodynamic equations and moves the rocking table by the appropriate amount.

Much work is also going into the preparation of advanced types of hydraulic-system component, designed "to give maximum reliability and performance, together with long seal life, yet have minimum bulk and weight." Intended for use in 4,000 lb/sq in systems, the units have been impulse-tested to ensure adequate fatigue life; elimination of stress concentrations has been a major aim. Other new developments are Durestos drop-tanks—made in collaboration with Bristol—and a parachute release unit incorporating a balanced operating mechanism which eliminates tendency to release under sudden shock-loads.

Simmonds Aerocessories, Ltd. Continuous development over many years has given the company the ability to offer equipment capable of measuring, controlling, analyzing and purifying the contents of aircraft fuel systems. The well-known Pacitor fuel gauge is now fully developed and the latest types of flow-meter give a mass reading and are thus unaffected by changes in fuel density.

New designs have also been prepared for specific-gravity meters, water-in-fuel detectors, tank-level controllers, fuel filters and field test equipment. A working rig has been prepared to demonstrate the Fram fuel filter/water separators and various other fuel-system items. Simmonds are, of course, also the manufacturers of Nyloc Stiffnuts and Spire Speed Nuts, screws and clips.

Smiths Aircraft Instruments, Ltd. The revolutionary Smiths Flight System, which we have lately described in detail, is "the most advanced example of integrated systems engineering yet made available to civil operators." It integrates a total of 17 conventional instrument functions into a single system with eight panel-mounted instruments. Another exceedingly advanced product is the SEP. 2 autopilot which has become standardized on most of the latest British transport aircraft.

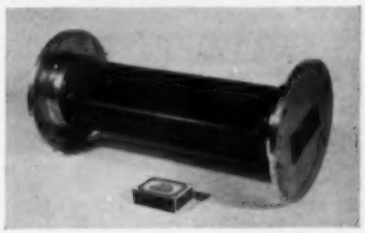


Smiths Flight System beam compass.

New engine instruments include a torquemeter pressure indicator using the Asynn system. Now in production is the new jet-pipe-temperature indicator available in various forms with a scale extending over 250 degrees of arc. Smiths are also responsible for an entirely new range of pressure-warning switches for supersonic aircraft in which ambient temperatures may well reach 250 deg C. Some of these switches have been designed with banjo fixings should it not be convenient to provide a suitable flange.

The Sperry Gyroscope Co., Ltd. A completely new instrument this year is the H.L.9 electric gyro-horizon. This instrument is operated off a direct-current system and is intended for use either as a primary flight instrument in aircraft not provided with an A.C. supply, or as a continuously-operating stand-by to provide a safeguard against failure of either the A.C. supply or of the primary flight instruments for any other reason. Production and development continue on a wide range of other gyro-horizons, gyro-magnetic compasses and Zero Reader flight directors.

One of several new designs of autopilot is the A.L.30, which has not yet been publicly described. The company are also well advanced in the development of the Integrated Control System for high-performance aircraft and a working rig has been built to demonstrate the characteristics of representative units of this system. The range of synchros and servo components is steadily being improved and new models are now under current development in the range of size 11 and 15 synchro units. Sperry are also already in production with a number of patterns of hydraulic pump and motor under licence from Vickers, Inc., of Detroit and several of these designs are now becoming available for application to British aircraft.



Tecalemit flexible waveguide.

Tecalemit, Ltd. Extensions have been made to the Titeflex range of ignition harness and screening conduit flex, and there are several new examples of filters and elements for all airborne fluids. A photograph shows a new departure: Gabriel Manufacturing Co., Ltd., of Torquay, an associate, are producing flexible and twistable waveguides which now include units for 10 cm systems.

Teddington Aircraft Controls, Ltd. A wide range of butterfly and barrel-type hot-gas valves is now available, with electric, pneumatic or manual operation. One model, Type FOZ, is a rotary (barrel) carbon valve, offering unrestricted passage when fully open (bore sizes ¼in to 1¼in). The FOZ units may have bodies of either light alloy or Ni-resist cast iron,

Teddington FOZ carbon plug valve.

ACCESSORY DEVELOPMENTS .

and one particular type—for hot-air windscreen de-icing—is moved by a manual lever, the initial opening movement of which actuates a snap-action switch controlling a fan. Another valve family is the FMP butterfly, available in light alloy or Ni-resist in sizes up to 5½in bore. The valve plates are sealed by split, square-section stainless-steel rings and the valve seat is spherical.

The most recent pressure-operated switch is the FPH/A/1, for high-pressure hydraulic systems. It will operate at any pre-set pressure between 2,000 and 3,000 lb/sq in (overload 3,500 lb/sq in) on a differential of 150 to 200 lb/sq in. Teddington also licence-produce pressure-transducers, accelerometers and potentiometers developed in California by G. M. Giannini, Inc., and also "Vernatherm" thermostatic power elements, which utilize the expansion of a solid housed in a slightly larger charge chamber to provide a linear temperature/movement characteristic. Other new products embrace such diverse fields as pneumatic pressure regulators and temperature controllers, rotating navigation lights and flashing units for warning systems, time switches for all purposes, miniature electronic amplifiers, tank-pressurization equipment and electric actuators.

Tiltman Langley, Ltd. Manufacture is in hand of prototype units incorporating the Hayes variable-ratio drive, suitable for connection to alternators in paralleled systems. It employs the familiar toroid disc and roller friction principle; one of the standard units is associated with a 30-kVA alternator and maintains an output speed of 8,000 r.p.m. over an input range from 3,000 to 10,000 r.p.m.

Another activity is the development of a remote-operated selector gear. Part of a larger device produced by the company in quantity, the gear uses solenoid-operated clutches and can be used for precise and repetitive operation over wide ranges of temperature.

Triplex Safety Glass Co., Ltd. Production is now in full swing on gold-film, electrically-heated panels for various purposes. As previously described, the outer panel bears a deposition of gold approximately 0.0000002in thick which carries the current without impairing vision. The company have made an effective demonstration rig in which a complete Comet windscreen panel, the inner portion of which is glazed with gold-film glass, has been built into a commercial refrigerator. Ice is allowed to form and is then disposed of by switching on the heated panel. Triplex are also in production with bullet-, bird- and pressure-proof, optically-polished, double-curvature panels for advanced types of aircraft. Display exhibits have been prepared showing bullet-proof glass after being struck by cannon shells.

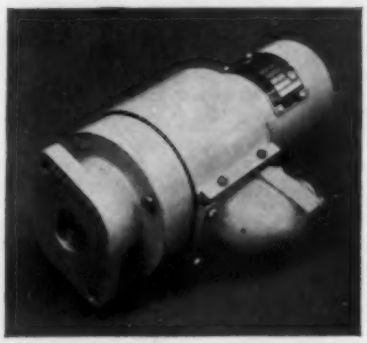
Vokes, Ltd. In accordance with the current programme of high-efficiency filter development, the company are now supplying filters capable of arresting extremely small particles, in addition to standard ranges suitable for engines, cabin air-conditioning systems and hot or cold air supplies.

Several types of filter are now in production for use in hydraulic systems, operating at both high and low pressure, and other products include silencers for cabin-air superchargers (such as are standardized on the Viscount) and such unusual items as "breathing panels" composed of numbers of small disc filters which are used on the fuselage of the Auster Agricola agricultural aircraft.

Waymouth Gauges and Instruments, Ltd. The highly accurate and reliable compensated fuel-contents system is now being extended by the Type 2 and Type 3 systems. Both are self-compensating and correct for any variation in the properties of a given range of fuels. Furthermore, the indications are that appreciable weight savings can be expected in comparison with the Type 1 system.

The Type 2 system uses a supply at 115-V at 400 c.p.s., whereas the Type 3 will function at 28-V D.C. In both instances the systems provide D.C. output which can operate two or more indicators from each amplifier, thus providing a straightforward method of operating current-sensitive devices for fuel management. Both the new systems are still in the development stage.

Western Manufacturing (Reading), Ltd. This company, based on the airfield at Woodley, have evolved a "Universal" range of electric actuators, with which great flexibility has been achieved. For each size of motor there are a number of externally identical gearboxes so that customers have a choice of moving a heavy load slowly or a light load more rapidly. Furthermore, different piston assemblies can be provided so that users requiring only a short stroke are not penalized by wasted length. With two such piston assemblies any stroke can be obtained from 0 to 3 in; alternatively a rotary output can



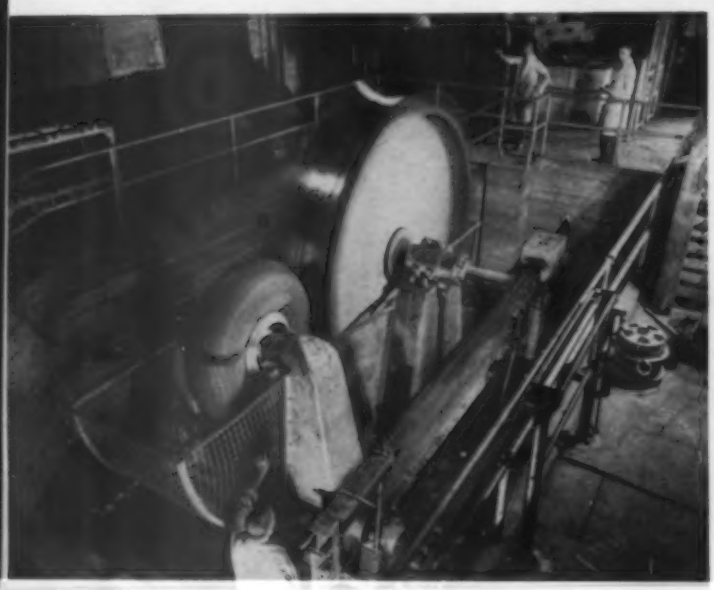
Western Manufacturing Type EROJ actuator.

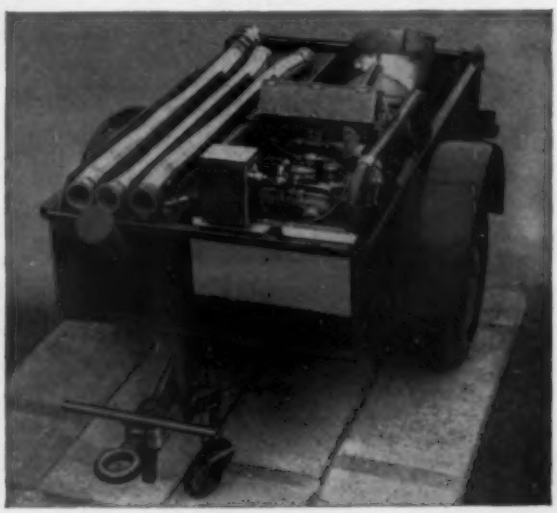
be obtained, adjusted to different rotational limits. Thus, with a minimum number of basic component parts, loads can be varied from 0 to 900 lb and operating time (full-stroke) between four and 16 sec. Other types of actuator are rated up to maximum working loads of 6,000 lb.

The company also manufacture a great variety of small electric motors and several patterns of switch, including multi-position rotary switches and units in which, by operating a push-button, an emergency high-speed movement can be obtained.

HIGH-PRESSURE DEVELOPMENT—IN TWO SENSES

The photograph on the left, below, was taken recently in the test establishment of the Dunlop Rubber Co., Ltd., at Fort Dunlop. It shows an aircraft tyre being run on the "double camber" test machine. The right-hand picture depicts a new aircraft ground-starter unit which is likely to be produced in quantity for British armed services. Powered by a Blackburn-Turboméca Palouste, it delivers a considerable flow of compressed air through flexible piping, to serve pneumatic starters which will be used on future types of gas turbine.





This 20 gallon per minute pump
has been developed and proved
— *and is in current use*

This compact, efficient, light and above all dependable VICKERS VARIABLE DISPLACEMENT PUMP has been proved and is a development of a similar pump in regular daily year-round service in many types of aircraft. It is scheduled for production in the United Kingdom by Sperry.
It brings to British Designers and Manufacturers a pump of outstanding power/weight ratio, infinitely variable delivery within its range up to 20 gallons per minute, effecting changes in delivery simply and smoothly at all stages.
If you have a design problem calling for a compact yet high-capacity hydraulic pump of *proved* performance, this is the answer.

VICKERS Type No. PV3915
PRESSURE: Up to 4,000 lb. per sq. in.
VOLUMETRIC EFFICIENCY: 96%
OVERALL EFFICIENCY: 92%
WEIGHT: 20 lb.
APPROXIMATE CLEARANCE DIMENSIONS: 9" × 9" × 7"

VICKERS

AIRCRAFT HYDRAULIC PUMPS & MOTORS

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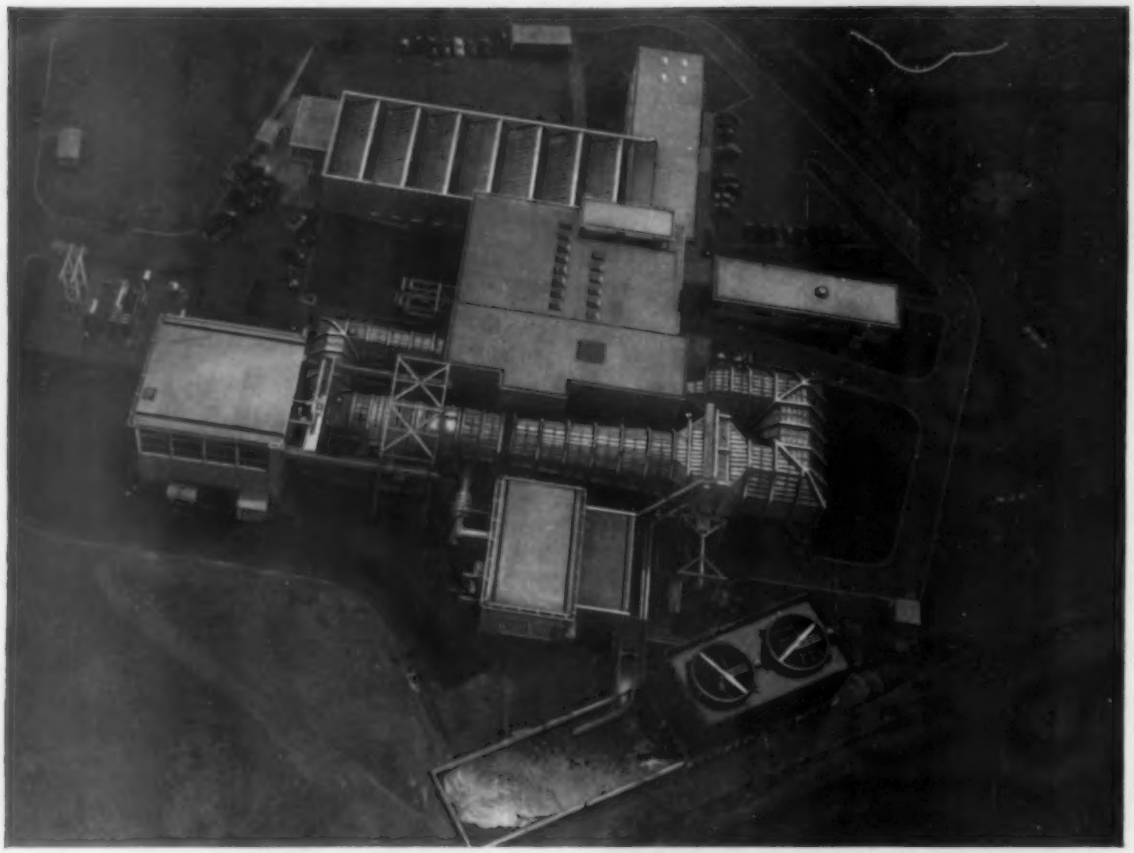

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This impressive aerial photograph
shows the general layout of the
TRANSONIC WIND TUNNEL BUILDINGS at Bedford
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IN the pages which follow, over 300 components, accessories, services, etc., are listed in ready-reference form, and under each heading are the names of over 500 firms whom we understand to be manufacturers or suppliers of such items. Their addresses are given at the end of the directory. Aircraft and engines are dealt with in detail in the special reviews earlier in this issue. Air-transport operations do not appear in these pages; they have their place in our annual Commercial Aviation Number, published in the spring. Firms exhibiting at the S.B.A.C. Show are, of course, included; a list of stand numbers appears on page 422.

THE ANCILLARY INDUSTRY

A Ready-reference Directory to Products and Firms

ADDRESSES OF FIRMS: pp. 417-422

A.G.S. PARTS
Abbey Panel and Sheet Metal Co., Ltd., The
Accles and Pollock, Ltd.
Acton Bolt, Ltd.
Aero Maintenance Equipment, Ltd.
Aerocontacts (Sales), Ltd.
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Aircraft Materials, Ltd.
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Aviation Traders, Ltd.
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Eagle Aircraft Services, Ltd.
Engineering Products, Ltd.
Field Aircraft Services, Ltd.
Guest, Keen and Nettlefolds (Midlands), Ltd.
Headland, Ltd., Thos. P.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Hickman, Ltd.
High Pressure Components, Ltd.
Kautex, Ltd.
King Aircraft Corporation
M.H.H. Engineering Co., Ltd.
Miller Aviation, Ltd.
Newton and Co., H. T.
Rawlplug Co., Ltd., The
Reynolds Tube Co., Ltd.
Rolls Razor, Ltd.
Ross, Courtney and Co., Ltd.
Ross, Ltd., S. Grahame
Rubery, Owen and Co., Ltd.
Simmonds Aerocessories, Ltd.
Standard Insulator Co., Ltd., The
Stone and Co. (Deptford), Ltd., J.
Talbot Stead Tube Co., Ltd.
Y.S.C., Ltd., The

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Van Moppes and Sons (Diamond Tools), Ltd., L. M.

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Dowty Equipment, Ltd.
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Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.
I. V. Pressure Controllers, Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Western Manufacturing (Reading), Ltd.

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Eastern Aero Electrical Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Lockheed Hydraulic Brake Co., Ltd.
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Miles, Ltd., F. G.
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Plessey Co., Ltd., The
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Vernons Industries, Ltd.
Western Manufacturing (Reading), Ltd.

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Cellon, Ltd.
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Hellermann, Ltd.
Imperial Chemical Industries, Ltd.
Kautex, Ltd.
Peradin and Watercraft, Ltd.
Rawlplug Co., Ltd., The
Steel and Co., Ltd., J. M.
Telegraph Construction and Maintenance Co., Ltd., The
Titanine, Ltd.

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Cole, Ltd., E. K.
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Easipower, Ltd.
Eastern Aero Electrical Services, Ltd.
Ekco Electronics, Ltd.
Field Aircraft Services, Ltd.
Helliwell's, Ltd.
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Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
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Whittemore (Aeradio), Ltd., A. J.

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Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Rollason Aircraft and Engines, Ltd.
Shackleton, Ltd., W. S.
Whittemore (Aeradio), Ltd., A. J.

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Avimo, Ltd.
Bell's Asbestos and Engineering Ltd.
Birlec, Ltd.
Boorn and Co., Ltd., Thomas
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de Havilland Propellers, Ltd.
Delaney Gallay, Ltd.
Dragonair, Ltd.
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Godfrey and Partners, Ltd., Sir George
Hymatic Engineering Co., Ltd., The
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Lucas (Gas Turbine Equipment), Ltd., Joseph
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Newton and Co., H. T.
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Pipework and Engineering (Bristol), Ltd.
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Teddington Aircraft Controls, Ltd.
Vokes, Ltd.

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Douglas (Contractors), Ltd., Robert M.

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Skyhi, Ltd.

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International Aeradio, Ltd.
Miles, Ltd., F. G.

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Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hordern Richmond (Sales), Ltd.
Jablo Plastics Industries, Ltd.
Rotol, Ltd.

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Hall and Pickles, Ltd.
Imperial Chemical Industries, Ltd.
Rapp, Ltd., Leo
Steel, Peech and Tozer, Ltd.

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Hall and Pickles, Ltd.
Rapp, Ltd., Leo
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Rollet and Co., Ltd., H.
Sterling Metals, Ltd.
Stone and Co. (Charlton), Ltd., J.
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Telegraph Construction and Maintenance Co., Ltd., The
Wilson and Sons (London), Ltd., W.

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General Electric Co., Ltd., The
Godfrey and Partners, Ltd., Sir George
Newton and Co., H. T.
Plessey Co., Ltd., The
Rotax, Ltd.
Rotol, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Birmetals, Ltd.
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High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
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Rapp, Ltd., Leo
Ravensbourne Metal Co., Ltd.
Rollet and Co., Ltd., H.
Sterling Metals, Ltd.
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THE ANCILLARY INDUSTRY...

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Martin-Baker Aircraft Co., Ltd.
Newton and Co., H. T.
Rolls Razor, Ltd.
Stewart Aeronautical Supply Co., Ltd.

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Dunlop Rubber Co., Ltd. (Aviation Division)
French and Sons, Ltd., Thomas
Leytonstone Jig and Tool Co., Ltd.
M.L. Aviation Co., Ltd.
Newton and Co., H. T.
Rolls Razor, Ltd.
Saunders-Roe, Ltd.
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Crane Packing, Ltd.
Delaney Gallay, Ltd.
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Walker and Co., Ltd., James
Wills Pressure Filled Joint Ring, Ltd.

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Brooklands Aviation, Ltd.
Fairey Aviation Co., Ltd., The
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Flight Refuelling, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Miles, Ltd., F. G.
Parnall and Co., Ltd., George
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Rollason Aerocessories Co., Ltd.
Samlesbury Engineering, Ltd.
Saunders-Roe, Ltd.

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Brooklands Aviation, Ltd.
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Easipower, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Miles, Ltd., F. G.
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Pressed Steel Co., Ltd.
Redwing, Ltd.
Reilly Engineering, Ltd.
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de Havilland Engine Co., Ltd., The
Plessey Co., Ltd., The
Ross, Ltd., S. Grahame
Rover Gas Turbines, Ltd.
Vernons Industries, Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Rumbold and Co., Ltd., L. A.
Vane and Co., A. H.

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Lea Bridge Industries, Ltd.
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Elliot Equipment, Ltd.
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Peradin and Watercraft, Ltd.
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Elliot Equipment, Ltd.
Lea Bridge Industries, Ltd.
Peradin and Watercraft, Ltd.
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Siebe, Gorman and Co., Ltd.

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Garringtons, Ltd.
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Jessop and Sons, Ltd., William
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Omes, Ltd.
Wilmot Breeden, Ltd.

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Ashdowns, Ltd.
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Long and Hambly, Ltd.

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Palmer Tyre, Ltd., The
Walter, A. J.

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Stone and Co. (Deptford), Ltd., J.
Wilson and Sons (London), Ltd., W.

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Rollet and Co., Ltd., H.
Sandwell Casting Co., Ltd., The
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Stone and Co. (Deptford), Ltd., J.
Yorkshire Engineering Supplies, Ltd.

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Cosely Engineering Co., Ltd., The
Douglas (Contractors), Ltd., Robert M.

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Brown Brothers (Aircraft), Ltd.
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Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Lancefield Aircraft Components, Ltd.
Newton and Co., H. T.
Teleflex Products, Ltd.

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C.W.C. Equipment, Ltd.
Cossor, Ltd., A. C.
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General Electric Co., Ltd., The
Henley's Wireless Telegraph Co., Ltd., W. T.
Newton and Co., H. T.
Rista Wires and Cables, Ltd.
Rotax, Ltd.
St. Helens Cable and Rubber Co., Ltd.
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Technograph Electronic Products, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

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Graseby Instruments, Ltd.
Helliwells, Ltd.
Munro, Ltd., R. W.
Newton and Co., H. T.
Rollason Aerocessories, Ltd.
Solartron Electronic Group, Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Pullin and Co., Ltd., R. B.
Stewart Aeronautical Supply Co., Ltd.
Vinten, Ltd., W.
Williamson Manufacturing Co., Ltd.

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Brown, Ltd., S. G.
Cossor, Ltd., A. C.
Harringay Photographic Supplies
Reid and Sigrist, Ltd.
Southern Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vinten, Ltd., W.

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Martin-Baker Aircraft Co., Ltd.
Western Manufacturing (Reading), Ltd.

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Helliwells, Ltd.
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Thermo-Plastics, Ltd.
Triplex Safety Glass Co., Ltd., The

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Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Mullard, Ltd.
Plessey Co., Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Jablo Plastics Industries, Ltd.

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Hobson, Ltd., H. M.
Newton and Co., H. T.
Stewart Aeronautical Supply Co., Ltd.

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Hadfields, Ltd.
High Duty Alloys, Ltd.
Kent Alloys, Ltd.
Northern Aluminium Co., Ltd.
Rollet and Co., Ltd., H.
Sandwell Casting Co., The
Sterling Metals, Ltd.
Stone and Co. (Charlton), Ltd., J.
Stone and Co. (Deptford), Ltd., J.
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Vosper, Ltd.
Wellworthy, Ltd.

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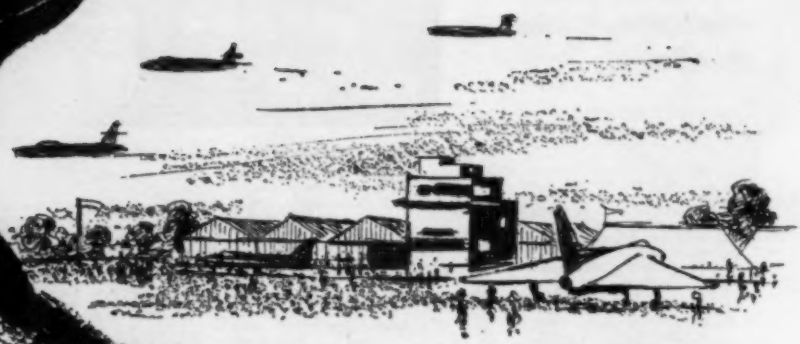

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Hadfields, Ltd.
Jessop and Sons, Ltd., William
Napier and Son, Ltd., D.
Telegraph Construction and Maintenance Co., Ltd., The

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Brown Foundries Co., The David
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H. and F. Precise Castings, Ltd.
Hadfields, Ltd.
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Salter and Co., Ltd., Geo.
Sandwell Casting Co., The
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Telegraph Construction and Maintenance Co., Ltd., The
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Pyrene Co., Ltd., The

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Vactric, Ltd.

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Cox and Son, Ltd., John
Docker Brothers
Irano Products, Ltd.
Kenilworth Manufacturing Co., Ltd., The
New Welbeck, Ltd.
Pyrene Co., Ltd., The
Rollason Aerocessories, Ltd.
Valay Industries, Ltd.
Walterisation Co., Ltd., The

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Avica Equipment, Ltd.
Bowden (Engineers), Ltd.
Brown Brothers (Aircraft), Ltd.
Dunlop Rubber Co., Ltd.
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Hellermann, Ltd.
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Ross, Courtney and Co., Ltd.
Simmonds Aerocessories, Ltd.
Standard Insulator Co., Ltd., The
Terry and Sons, Ltd., Herbert

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Irving Air Chute of Great Britain, Ltd.
Lewis, Ltd., D.
M.L. Aviation Co., Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Suchy Holdings, Ltd.

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Anticoustic Co., The
Bell's Asbestos and Engineering, Ltd.
Fothergill and Harvey (Sales), Ltd.
Frankenstein and Sons (Manchester), Ltd., P.
Hellermann, Ltd.
Lea Bridge Industries, Ltd.
Lewis, Ltd., D.
R.F.D. Co., Ltd.
Siebe, Gorman and Co., Ltd.
Suchy Holdings, Ltd.
Turner Brothers Asbestos Co., Ltd.
Wilkinson Rubber Linatex, Ltd.

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Fishers
Frankenstein and Sons (Manchester), Ltd., P.
Gieves, Ltd.
Suchy Holdings, Ltd.

COMMUNICATION SYSTEMS, AIRCRAFT INTERIOR
Aerocontacts (Sales), Ltd.
British Thomson-Houston Co., Ltd. The
Brown, Ltd., S. G.
E.R.S. (London), Ltd.
Fonadek (Branson), Ltd.
General Electric Co., Ltd., The
Murphy Radio, Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Racal, Ltd.
Redifon, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

COMPONENTS, AIRFRAME (see also Assemblies, Major Airframe)
Aerocontacts (Sales), Ltd.
Air Service Training, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Boulton Paul Aircraft, Ltd.
Brooklands Aviation, Ltd.
Brown Brothers (Aircraft), Ltd.
Burgess and Co., Ltd., G. H.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hadfields, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Jablo Plastics Industries, Ltd.
Jig Design Co., The
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Redwing, Ltd.
Rollason Aerocessories, Ltd.
Rolls Razor, Ltd.
Samlesbury Engineering, Ltd.
Saunders-Roe, Ltd.
Standard Insulator Co., Ltd., The
Taylor (Metal-Workers), Ltd., C. F.
Western Manufacturing (Reading), Ltd.

COMPONENTS AND DETAILS, ELECTRONIC
Aerocontacts (Sales), Ltd.
Aircraft Marine Products (Great Britain), Ltd.
Air Trainers, Ltd.
Avimo, Ltd.
Belling and Lee, Ltd.
British Thomson-Houston Co., Ltd.
Brown, Ltd., S. G.
Burgess and Co., Ltd., G. H.
Cathodeon, Ltd.
Crane Packing, Ltd.
Dowty Nucleonics, Ltd.
Eagle Aircraft Services, Ltd.
E.R.S. (London), Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Field Aircraft Services, Ltd.
Gabriel Manufacturing Co., Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
Honeywell-Brown, Ltd.
Jig Design Co., The
Lancefield Aircraft Components, Ltd.
McMichael Radio, Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Mullard, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Reilly Engineering, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Simmonds Aerocessories, Ltd.
Solartron Electronic Group, Ltd., The
Sperry Gyroscope Co., Ltd.
Standard Insulator Co., Ltd., The
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Technograph Electronic Products, Ltd.
Thorn Electrical Industries, Ltd.
Vactric, Ltd.
Whittemore (Aeradio), Ltd., A. J.

COMPONENTS, ENGINE, GENERAL
Aerocontacts (Sales), Ltd.
Avica Equipment, Ltd.
Brown Brothers (Aircraft), Ltd.
Coopers Mechanical Joints, Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Integral, Ltd.
King Aircraft Corporation
M.H.H. Engineering Co., Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., The
Lucas (Gas Turbine Equipment), Ltd., Joseph
Pipework and Engineering (Bristol), Ltd.
Pullin and Co., Ltd., R. B.
Reynolds Tube Co., Ltd.
Rolls Razor, Ltd.
Ross, Ltd., S. Grahame
Spa Guilds, Ltd.
Tiltman Langley, Ltd.
Wellworthy, Ltd.
Yorkshire Engineering Supplies, Ltd.

COMPONENTS, GAS-TURBINE SHEET METAL
Briggs Motor Bodies, Ltd.
Burnley Aircraft Products, Ltd.
Clifford Products, Ltd.
Cornercroft, Ltd.
Delaney Gallay, Ltd.
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Pipework and Engineering (Bristol), Ltd.
Sankey and Sons, Ltd., Joseph
Thompson Bros. (Bilston), Ltd.

COMPRESSORS, INDUSTRIAL
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Clapham Park Motors, Ltd.,
English Electric Co., Ltd.
Godfrey and Partners, Ltd., Sir George
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.
Newton and Co., H. T.
Siebe, Gorman and Co., Ltd.
Skyhi, Ltd.
Williams and James (Engineers), Ltd.

COMPUTORS, ANALOGUE, AND EQUIPMENT
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Saunders-Roe, Ltd.
Short Brothers and Harland, Ltd.
Southern Instruments, Ltd.

CONNECTORS, ELECTRICAL
Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Aircraft Marine Products (Great Britain), Ltd.
Belling and Lee, Ltd.
Brown Brothers (Aircraft), Ltd.
C.W.C. Equipment, Ltd.
E.R.S., Ltd.
Easipower, Ltd.
Eastern Aero Electrical Services, Ltd.
General Electric Co., Ltd., The
M.L. Aviation Co., Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Rists Wires and Cables, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Vosper, Ltd.
Waymouth Gauges and Instruments, Ltd.
Whittemore (Aeradio), Ltd., A. J.

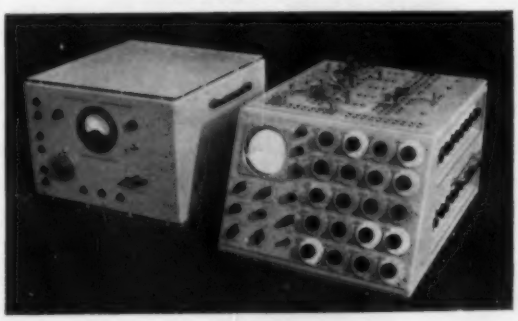
CONNECTORS, HOSE
Aerocontacts (Sales), Ltd.
Air Service Training, Ltd.
Avimo, Ltd.
Bell's Asbestos and Engineering, Ltd.
Boorn and Co., Ltd., Thomas
Brown Brothers (Aircraft), Ltd.
Flight Refuelling, Ltd.
Hall and Hall, Ltd.
High-Pressure Components, Ltd.
Hymatic Engineering Co., Ltd., The
I.V. Pressure Controllers, Ltd.
Maricon, Ltd.
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Peradin and Watercraft, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame

CONSULTANT SERVICES
Aerocontacts (Aircraft Distributors), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Airwork, Ltd.
Aviation and Engineering Projects, Ltd.
Aviation Traders (Engineering), Ltd.
Eagle Aircraft Services, Ltd.
Derby Aviation, Ltd.
Dunlop Rubber Co., Ltd., Dulon Division
Helliwells, Ltd.
International Aeradio, Ltd.
Mining and Chemical Products, Ltd.
Newton and Co., H. T.
Power Jets (Research and Development), Ltd.
Racal Electronics, Ltd.
Shackleton, Ltd., W. S.
Sutton (Consultants), Ltd., R. W.
Tiltman Langley, Ltd.
Whittemore (Aeradio), Ltd., A. J.

CONTROLS, ENGINE
Aero Controls, Ltd.
Bloctube Controls, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Elliott Brothers (London), Ltd.
Exactor, Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Irwin and Partners, Ltd., E. G.
I.V. Pressure Controllers, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Rotol, Ltd.
Samlesbury Engineering, Ltd.
Teleflex Products, Ltd.
Ultra Electric, Ltd.
Venner, Ltd.
Western Manufacturing (Reading), Ltd.

CONTROLS, FLYING
Aero Controls, Ltd.
British Messier, Ltd.
Brown, Ltd., S. G.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Leytonstone Jig and Tool Co., Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Rotax, Ltd.
Samlesbury Engineering, Ltd.
Sperry Gyroscope Co., Ltd.
Teleflex Products, Ltd.
Western Manufacturing (Reading), Ltd.
Wilmot Breeden, Ltd.

Saunders-Roe miniputer.



THE ANCILLARY INDUSTRY...

CONTROLS, POWERED
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Hobson, Ltd., H. M.
Lockheed Hydraulic Brake Co., Ltd.
Sperry Gyroscope Co., Ltd.

COOLANTS
Esso Petroleum Co., Ltd.

COPPER
Booth and Co., Ltd., James
British Insulated Callender's Cables, Ltd.
Imperial Chemical Industries, Ltd.
Lea Bridge Industries, Ltd.
Ravensbourne Metal Co., Ltd.
Rollet and Co., Ltd., H.
Telegraph Construction and Maintenance Co., Ltd., The

CORROSION INHIBITORS AND EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Brent Chemical Products, Ltd.
Crane Packing, Ltd.
Esso Petroleum Co., Ltd.
Ferro Enamels, Ltd.
Lea Bridge Industries, Ltd.
Peradin and Watercraft, Ltd.
Pyrene Co., Ltd., The
St. Helens Cable and Rubber Co., Ltd.
Skyhi, Ltd.
Steel and Co., Ltd., J. M.
Valay Industries, Ltd.
Wakefield and Co., Ltd., C. C.
Wakefield-Dick Industrial Oils, Ltd.
Walterisation Co., Ltd., The

COUPLINGS, FLEXIBLE (see also Joints, Universal)
Accles and Pollock, Ltd.
Automotive Products Co., Ltd.
Avimo, Ltd.
Brown Industries, Ltd., David
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Flight Refuelling, Ltd.
Garringtons, Ltd.
Hardy Spicer, Ltd.
High-Pressure Components, Ltd.
I.V. Pressure Controllers, Ltd.
King Aircraft Corporation
Laycock Engineering, Ltd.
Peradin and Watercraft, Ltd.
Renold Chains, Ltd.
Rose Brothers (Gainsborpugh), Ltd.

COVERS, AIRCRAFT, ETC.
Aero Maintenance Equipment, Ltd.
Brand and Co., Ltd., R. A.
Clapham Park Motors, Ltd.
Elliot Equipment, Ltd.
Fothergill and Harvey (Sales), Ltd.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Lea Bridge Industries, Ltd.
R.F.D. Co., Ltd.
Rumbold and Co., Ltd., L. A.

DAMPERS, CONTROL
Girling, Ltd.

DAMPERS, GENERAL MOTION
Honeywell-Brown, Ltd.
Reilly Engineering, Ltd.
Westminster Airways Servicing, Ltd.

DECARBONIZING PREPARATIONS AND EQUIPMENT
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Bennett (Hyde), Ltd.
Brent Chemical Products. Ltd.
Modern Industrial Finishes, Ltd.

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Bennett (Hyde), Ltd.
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Dawe Instruments, Ltd.
Docker Brothers
Imperial Chemical Industries, Ltd.
Irano Products, Ltd.
Pyrene Co., Ltd., The
Walterisation Co., Ltd., The

DE-ICING AND ANTI-ICING EQUIPMENT AND FLUIDS, ETC.
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Aerocontacts (Sales), Ltd.
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Delaney Gallay, Ltd.
Dragonair, Ltd.
Dunlop Rubber Co., Ltd.
Esso Petroleum Co., Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Harley Aircraft Landing Lamps
Kenilworth Manufacturing Co., Ltd., The
Kilfrost, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Manchester Oil Refinery (Sales), Ltd.
Napier and Son, Ltd., D.
Palmer Tyre, Ltd., The
Plessey Co., Ltd., The
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Rotol, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Serck Radiators, Ltd.
Stone and Co. (Deptford), Ltd., J.
T.K.S. (Aircraft De-Icing), Ltd.
Teddington Aircraft Controls, Ltd.
Thermo-Plastics, Ltd.
Thompson Bros. (Bilston), Ltd.
Zwicky, Ltd.

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Aerocontacts (Ground Equipment), Ltd.
Aeronautical Radio Services, Ltd.
Air Service Training, Ltd.
Airwork, Ltd.
Aviation and Engineering Projects, Ltd.
Aviation Traders (Engineering), Ltd.
Avimo, Ltd.
Baynes Aircraft Interiors, Ltd.
Boulton Paul Aircraft, Ltd.
Brown, Ltd., S. G.
Burgess and Co., Ltd., G. H.
City Electrical Co.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Douglas Equipment, Ltd.
E.M.O. Instrumentation, Ltd.
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Flight Refuelling, Ltd.
Frankenstein and Sons (Manchester), Ltd., P.
Graseby Instruments, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
I.V. Pressure Controllers, Ltd.
Irving Air Chute of Great Britain, Ltd.
Irwin and Partners, Ltd., E. G.
Jameson Aero Engines, Ltd.
Jameson, Ltd., J. L.
Jig Design Co., The
King Aircraft Corporation
Lansing Bagnall, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Light Engineering Designs (Gosport), Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
M. L. Aviation Co., Ltd.
Mollart Engineering Co., Ltd., The
Murphy Radio, Ltd.
North West Machine Design Co., Ltd.
Opperman, Ltd., S. E.
Palmer Tyre, Ltd., The
Pipework and Engineering (Bristol), Ltd.
Plessey Co., Ltd., The
Power Jets (Research and Development), Ltd.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rose Brothers (Gainsborough), Ltd.
Ross, Ltd., S. Grahame
Test Equipment, Ltd.
Test Equipment (Models), Ltd.
Thermo-Plastics, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Tiltman Langley, Ltd.

DIALS, INSTRUMENT
Dent and Co. and Johnson, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Simmonds Aerocessories, Ltd.
Smiths Aircraft Instruments, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.
Wynnstruments, Ltd.

DIAPHRAGMS
Crane Packing, Ltd.
Dunlop Rubber Co., Ltd.
Elliot Equipment, Ltd.
Hall and Hall, Ltd.
Mechanism, Ltd.
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.
Newton and Co., H. T.
Peradin and Watercraft, Ltd.
Trist and Co., Ltd., Ronald

DINGHIES
Aerocontacts (Sales,) Ltd.
Dart Aircraft, Ltd.
Fairey Aviation Co., Ltd., The
Frankenstein and Sons (Manchester), Ltd., P.
Jablo Plastics Industries, Ltd.
Lea Bridge Industries, Ltd.
Newton and Co., H. T.
R.F.D. Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

DOCKS, AIRCRAFT MAINTENANCE
Aerocontacts (Ground Equipment), Ltd.
Coseley Engineering Co., Ltd., The
Hawksley S. M. D., Ltd.
Heston Aircraft Co., Ltd., The
Opperman, Ltd., S. E.
Ross, Ltd., S. Grahame
Saunders-Roe, Ltd.

DOPES.—see Finishes

DRAWING OFFICE EQUIPMENT
Mavitta Drafting Machines, Ltd.
Mollart Engineering Co., Ltd., The

DRAWING OFFICE SERVICES (see also Design and Experimental Work)
Aerocontacts (Ground Equipment), Ltd.
Air Service Training, Ltd.
Airwork, Ltd.
Aviation and Engineering Projects, Ltd.
Aviation Traders (Engineering), Ltd.
Avimo, Ltd.
Baynes Aircraft Interiors, Ltd.
Burgess and Co., Ltd., G. H.
Eagle Aircraft Services, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Irwin and Partners, Ltd., E. G.
Jig Design Co., The
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
Light Engineering Designs (Gosport), Ltd.
Miles, Ltd., F. G.
North West Machine Design Co., Ltd.
Ross, Ltd., S. Grahame
Staines and Partners, Ltd., J. R.
Test Equipment (Models), Ltd.
Thompson (Engineers), Ltd., Raymond F.
Tiltman Langley, Ltd.

EAR DEFENDERS
Anticoustic Co., The
Mallock-Armstrong Co., The
Siebe, Gorman and Co., Ltd.

ELECTRICAL EQUIPMENT, GENERAL
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Avimo, Ltd.
British Thomson-Houston Co., Ltd. The
C.W.C. Equipment, Ltd.
City Electrical Co.
Cole, Ltd., E. K.
Dowty Nucleonics, Ltd.
E. R. S. (London), Ltd.
Easipower, Ltd.
Ekco Electronics, Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
French and Sons, Ltd., Thomas
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Hants and Sussex Aviation, Ltd.
Harley Aircraft Landing Lamps
Hellermann, Ltd.
M. L. Aviation Co., Ltd.
Measuring Instruments (Pullin), Ltd.
Newmark, Ltd., Louis
Newton Brothers (Derby), Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Salford Electrical Instruments, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Stone and Co. (Deptford), Ltd. J.
Stone and Co. (Charlton), Ltd., J.
Vernons Industries, Ltd.
Western Manufacturing (Reading), Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.
Wynnstruments, Ltd.

ELECTRONIC EQUIPMENT, GENERAL (see also Components and Details, Electronic)
Aerocontacts (Sales), Ltd.
Air Trainers, Ltd.
Anticoustic Co., The
Avimo, Ltd.
Belling and Lee, Ltd.
Boulton Paul Aircraft, Ltd.
British Communications Corporation, Ltd.
British Thomson-Houston Co., Ltd., The
Cole, Ltd., E. K.
Cossor, Ltd., A. C.
Dowty Nucleonics, Ltd.
E.M.I., Ltd.
E.R.S. (London), Ltd.
Ekco Electronics, Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Mullard, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Racal Engineering, Ltd.
Reilly Engineering, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermionic Products, Ltd.
Thorn Electrical Industries, Ltd.
Ultra Electric, Ltd.
Vactric, Ltd.
Wayne Kerr Laboratories, Ltd., The
Whittemore (Aeradio), Ltd., A. J.

ENGINE COMPONENTS GENERAL (piston engines)
Aerocontacts (Sales), Ltd.
Brown Brothers (Aircraft), Ltd
Brown Industries, Ltd., David
Dart Aircraft, Ltd.
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Hobson, Ltd., H. M.
Jessop and Sons, Ltd., William
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
Newman Industries, Ltd.
Newton and Co., H. T.
Pipework and Engineering (Bristol), Ltd.
Reynolds Tube Co., Ltd.
Rolls Razor, Ltd.
Yorkshire Engineering Supplies, Ltd.

ENGINE COMPONENTS, GENERAL (gas turbines)
Brown Brothers (Aircraft), Ltd.
Brown Industries, Ltd., David
Burnley Aircraft Products, Ltd.
Coopers Mechanical Joints, Ltd.
Dart Aircraft, Ltd.
Dowty Fuel Systems, Ltd.
Hobson, Ltd., H. M.
I.V. Pressure Controllers, Ltd.
Integral, Ltd.
Jessop and Sons, Ltd., William
King Aircraft Corporation

(*Continued on page* 409)

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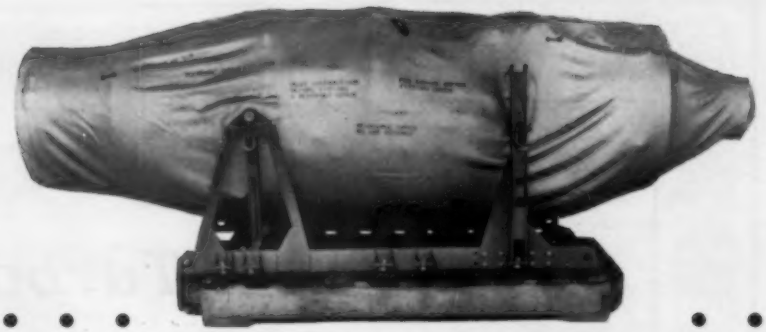

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Engine Components, General (Gas Turbines) (Continued)

Leytonstone Jig and Tool Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Pipework and Engineering (Bristol), Ltd.
Reynolds Tube Co., Ltd.
Rover Gas Turbines, Ltd.
Sankey and Sons, Ltd., Joseph
Yorkshire Engineering Supplies, Ltd.

ENGINE STARTERS AND STARTING EQUIPMENT (see also Ground Power Units)

Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
British Thomson-Houston Co., Ltd., The
City Electrical Co.
Clapham Park Motors, Ltd.
de Havilland Engine Co., Ltd., The
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
I. V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Newton and Co., H. T.
Partridge, Wilson and Co., Ltd.
Petbow, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Standard Telephones and Cables, Ltd.
Vernons Industries, Ltd.
Westinghouse Brake and Signal Co., Ltd.

EXPERIMENTAL WORK (see Design)

EXTRUSIONS, LIGHT ALLOY

Birmetals, Ltd.
Booth and Co., Ltd., James
Garringtons, Ltd.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Northern Aluminium Co., Ltd.
Rollet and Co., Ltd., H.
Southern Forge, Ltd.
T.I. Aluminium, Ltd.
Wiggin and Co., Ltd., Henry
Wilson and Sons (London), Ltd., W.

EXTRUSIONS, STEEL

Garringtons, Ltd.
Low Moor Alloy Steelworks, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph

FABRICATIONS, SHEET METAL

Abbey Panel and Sheet Metal Co., Ltd., The
Aviation Traders (Engineering), Ltd.
Briggs Motor Bodies, Ltd.
Burgess and Co., Ltd., G. H.
Burnley Aircraft Products, Ltd.
Clifford Products, Ltd.
Cornercroft, Ltd.
Dancer and Hearne Bros., Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
H.M.L. (Engineering), Ltd.
Harvey and Co. (London), Ltd., G.A.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Hickman, Ltd.
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Microcell, Ltd.
Opperman, Ltd., S. E.
Pipework and Engineering (Bristol), Ltd.
Pressed Steel Co., Ltd.
R.F.D. Co., Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Samlesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Taylor (Metal-Workers), Ltd., C. F.
Thompson Bros. (Bilston), Ltd.
Tiltman Langley, Ltd.
Vosper, Ltd.
Wilmot Breeden, Ltd.

FABRICATIONS, TUBULAR

Abbey Panel and Sheet Metal Co., Ltd., The
Accles and Pollock, Ltd.
Aviation Traders (Engineering), Ltd.
Burgess and Co., Ltd., G. H.
Dancer and Hearne Bros., Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
H.M.L. (Engineering), Ltd.
Heston Aircraft Co., Ltd., The
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Opperman, Ltd., S. E.
Pipework and Engineering (Bristol), Ltd.
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
Talbot Stead Tube Co., Ltd.

FABRIC, AIRFRAME

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Brown Brothers (Aircraft), Ltd.
Field Aircraft Services, Ltd.
Helliwells, Ltd.
R.F.D. Co., Ltd.
Samlesbury Engineering, Ltd.
Vane and Co., A. H.

FABRIC, CABIN FURNISHING

Aerocontacts (Sales), Ltd.
Bell's Asbestos and Engineering, Ltd.
Connolly Bros. (Curriers), Ltd.
Cox and Son, Ltd., John
Fothergill and Harvey (Sales), Ltd.
Latex Upholstery, Ltd.
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
Vane and Co., A. H.

FANS (see also Wind Tunnels and Equipment)

Airscrew Co. and Jicwood, Ltd., The
General Electric Co., Ltd., The
Godfrey and Partners, Ltd., Sir George
Hordern-Richmond (Sales), Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vactric, Ltd.

FASTENERS, COWLING AND SPECIAL PURPOSE

Aerocontacts (Sales), Ltd.
Amal, Ltd.
Aviation Developments, Ltd.
Baynes Aircraft Interiors, Ltd.
Cox and Son, Ltd., John
Dzus Fastener, Europe, Ltd.
Fairey Aviation Co., Ltd., The
King Aircraft Corporation
M. L. Aviation Co., Ltd.
Oddie, Bradbury and Cull, Ltd.
Ross, Ltd., S. Grahame
Simmonds Aerocessories, Ltd.
Wilmot Breeden, Ltd.

FILLER, FOR TUBE BENDING

Mining and Chemical Products, Ltd.

FILTERS, AIR AND GAS

Coopers Mechanical Joints, Ltd.
Dunlop Rubber Co., Ltd.
Exactor, Ltd.
Fibreglass, Ltd.
I.V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Palmer Tyre, Ltd., The
Vokes, Ltd.

FILTERS, ELECTRICAL

General Electric Co., Ltd., The
McMichael Radio, Ltd.
Mullard, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

FILTERS, FLUID

Amal, Ltd.
Auto-Klean Strainers, Ltd.
Automotive Products Co., Ltd.
Coopers Mechanical Joints, Ltd.
Dunlop Rubber Co., Ltd.
Fairey Aviation Co., Ltd.
H.M.L. (Engineering), Ltd.
I. V. Pressure Controllers, Ltd.
King Aircraft Corporation
Machine Products, Ltd.
Philips Electrical, Ltd.
Plessey Co., Ltd., The
Self-Priming Pump and Engineering Co., Ltd.
Simmonds Aerocessories, Ltd.
Simmons and Hawker, Ltd.
Stream-Line Filters, Ltd.
Tecalemit, Ltd.
Thompson Bros. (Bilston), Ltd.
T.K.S. (Aircraft De-Icing), Ltd.
Vokes, Ltd.
Zwicky, Ltd.

FINISHES, AIRCRAFT (see also Paints)

Aerocontacts (Sales), Ltd.
British Paints, Ltd.
Cellon, Ltd.
Docker Brothers
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Modern Industrial Finishes, Ltd.
Ryland, Ltd., Llewellyn
Saro Laminated Wood Products, Ltd.
Titanine, Ltd.

FIRE FIGHTING AND DETECTION EQUIPMENT, AIRBORNE

Cathodeon, Ltd.
General Fire Appliance Co., Ltd.
Graviner Manufacturing Co., Ltd.
Kidde Co., Ltd., The Walter
Pyrene Co., Ltd., The
Scottish Aviation, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermal Control Co., Ltd.

FIRE FIGHTING EQUIPMENT GROUND

Aerocontacts (Ground Equipment), Ltd.
Bell's Asbestos and Engineering, Ltd.
Douglas Equipment, Ltd.
Foamite, Ltd.
General Fire Appliance Co., Ltd.
International Aeradio, Ltd.
Kidde Co., Ltd., The Walter
Microcell, Ltd.
Pyrene Co., Ltd., The
R.F.D. Co., Ltd.
Rover Gas Turbines, Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

FLAME TRAPS

Amal, Ltd.
Avimo, Ltd.

FLOTATION GEAR

Frankenstein and Sons (Manchester), Ltd., P.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., The Walter
R.F.D. Co., Ltd.
Ross, Ltd., S. Grahame

FLUID, HYDRAULIC

Esso Petroleum Co., Ltd.
Kenilworth Manufacturing Co., Ltd., The
Lockheed Hydraulic Brake Co., Ltd.
Wakefield and Co., Ltd., C. C.

FLUIDS, ETC., INDUSTRIAL (other than under separate headings)

Esso Petroleum Co., Ltd.

FORGINGS, DROP

English Steel Forge and Engineering Corporation, Ltd.
Firth-Derihon Stampings, Ltd., The
Garringtons, Ltd.
High Duty Alloys, Ltd.
Hughes-Johnson Stampings, Ltd., The
Omes, Ltd.
Smith-Clayton Forge, Ltd.
Smith's Stamping Works (Coventry), Ltd.
Steel, Peech and Tozer.

FORGINGS IN HEAT-RESISTING MATERIALS

Brown Bayley Steels, Ltd.
Firth-Vickers Stainless Steels, Ltd.
Hadfields, Ltd.
Hughes-Johnson, Stampings, Ltd., The
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Omes, Ltd.
Steel, Peech and Tozer
Tubes, Ltd.
Wiggin and Co., Ltd., Henry

FORGINGS, LIGHT ALLOY

Birmetals, Ltd.
Garringtons, Ltd.
Hadfields, Ltd.
High Duty Alloys, Ltd.
Hughes-Johnson Stampings, Ltd., The
Northern Aluminium Co., Ltd.
Omes, Ltd.
Southern Forge, Ltd.
Stone and Co. (Charlton), Ltd., J.
Stone and Co. (Deptford), Ltd., J.

FORGINGS, STEEL

Brown Bayley Steels, Ltd.
English Steel Forge and Engineering Corporation, Ltd.
Firth and John Brown, Ltd., Thos.
Firth-Vickers Stainless Steels, Ltd.
Garringtons, Ltd.
Hadfields, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Omes, Ltd.
Smith-Clayton Forge, Ltd.
Smith's Stamping Works (Coventry), Ltd.
Steel, Peech and Tozer
Tubes, Ltd.

FORGINGS, OTHER THAN ABOVE

Hadfields, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Omes, Ltd.
Stone and Co. (Charlton), Ltd., J.
Tubes, Ltd.

FREIGHT HANDLING EQUIPMENT, AIRPORT

Aerocontacts (Ground Equipment), Ltd.
Aviation Traders (Engineering), Ltd.
Dart Aircraft, Ltd.
Lansing Bagnall, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame

FREIGHT EQUIPMENT, AIRBORNE

Aviation Traders (Engineering), Ltd.
Burgess and Co., Ltd., G. H.
Dart Aircraft, Ltd.
Electro-Hydraulics, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame

FRICTION LININGS

British Belting and Asbestos, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.

FUELS, AIRCRAFT

British Petroleum Co., Ltd., The
Esso Petroleum Co., Ltd.
Shell-Mex and B.P., Ltd.

FUELS, ROCKET, ETC

British Oxygen Gases, Ltd.
British Petroleum Co., Ltd., The
Laporte Chemicals, Ltd.

FUELLING EQUIPMENT

Aerocontacts (Ground Equipment), Ltd.
Automotive Products Co., Ltd.
Avery-Hardoll, Ltd.
Douglas Equipment, Ltd.
Exactor, Ltd.
Flight Refuelling, Ltd.
I.V. Pressure Controllers, Ltd.
Lancefield Aircraft Components, Ltd.
Saunders-Roe, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Simmons and Hawker, Ltd.
Stemco, Ltd.
Stream-Line Filters, Ltd.
Thompson Bros. (Bilston), Ltd.
Vosper, Ltd.
Wayne Tank and Pump Co., Ltd.
Wilmot Breeden, Ltd.
Zwicky, Ltd.

FUEL MEASUREMENT EQUIPMENT

Amal, Ltd.
Avery-Hardoll, Ltd.
Elliott Brothers (London), Ltd.
Exactor, Ltd.
Honeywell-Brown, Ltd.
Integral, Ltd.
Kent, Ltd., George
Negretti and Zambra, Ltd.
Ross, Ltd., S. Grahame
Rotol, Ltd.
Simmonds Aerocessories, Ltd.
Simmons and Hawker, Ltd.
Stemco, Ltd.
Waymouth Gauges and Instruments, Ltd.

New Tecalemit-Foamite crash fire tender.

THE ANCILLARY INDUSTRY...

FUEL SYSTEMS, ENGINE
Abbey Panel and Sheet Metal Co., Ltd., The
Dowty Fuel Systems, Ltd.
Electro-Hydraulics, Ltd.
Exactor, Ltd.
Fairey Aviation Co., Ltd., The
Flight Refuelling, Ltd.
Hymatic Engineering Co., Ltd., The
I.V. Pressure Controllers, Ltd.
King Aircraft Corporation
Lucas (Gas Turbine Equipment), Ltd., Joseph
Plessey Co., Ltd., The
Self-Priming Pump and Engineering Co., Ltd.
Wilmot Breeden, Ltd.

FURNISHING EQUIPMENT, AIRCRAFT
Aerocontacts (Sales), Ltd.
Baynes Aircraft Interiors, Ltd.
Dart Aircraft, Ltd.
Irwin and Partners, Ltd., E. G.
Lancefield Aircraft Components, Ltd.
Parnall and Co., Ltd., George
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.

FUSES
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Belling and Lee, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Stewart Aeronautical Supply Co., Ltd.
City Electrical Co.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Newman Industries, Ltd.
Newton and Co., H. T.
Newton Brothers (Derby), Ltd.
Petbow, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.
Whittemore (Aeradio), Ltd., A. J.

GLASS, SAFETY
Suntex Safety Glass Industries, Ltd.
Triplex Safety Glass Co., Ltd., The

GRINDING EQUIPMENT
(see also Tools, Machine)
Black and Decker, Ltd.
Desoutter Brothers, Ltd.
Flexible Drives (Gilmans), Ltd.
Leytonstone Jig and Tool Co., Ltd.
Precision Diamond Products, Ltd.
Reilly Engineering, Ltd.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.

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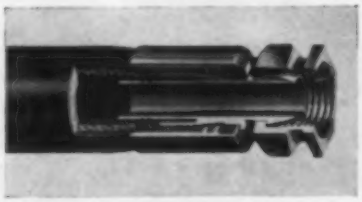
(see also Engine Starters)
Aerocontacts (Ground Equipment), Ltd.
Chloride Batteries, Ltd.
Aero Maintenance Equipment, Ltd.
City Electrical Co.
Clapham Park Motors, Ltd.
Eastern Aero Electrical Services, Ltd.
Murex Welding Processes, Ltd.



"Silvoflex" hose in part section, showing safety sealing zones for end fitting (The Palmer Tyre, Ltd.).

GALLEY EQUIPMENT
Baynes Aircraft Interiors, Ltd.
Burgess and Co., Ltd., G. H.
Dart Aircraft, Ltd.
General Electric Co., Ltd., The
Jablo Plastics Industries, Ltd.
Ross, Ltd., S. Grahame

GASKETS
Bell's Asbestos and Engineering, Ltd.
Coopers Mechanical Joints, Ltd.
Crane Packing, Ltd.
Dunlop Rubber Co., Ltd.
Hall and Hall, Ltd.
Jablo Plastics Industries, Ltd.
Kautex, Ltd.
Microcell, Ltd.
Peradin and Watercraft, Ltd.
Precision Rubbers, Ltd.
Trist and Co., Ltd., Ronald
Turner Brothers Asbestos Co., Ltd.
Walker and Co., Ltd., James

GAUGES, STRAIN
General Electric Co., Ltd., The
Philips Electrical, Ltd.
Salford Electrical Instruments, Ltd.
Saunders-Roe, Ltd.
Solartron Electronic Group, Ltd., The
Technograph Electronic Products, Ltd

GEARS AND GEAR SYSTEMS
Aero Controls, Ltd.
British Thomson-Houston Co., Ltd., The
Brown Gears (London), Ltd., David
Brown, Ltd., S. G.
Campbell (Engineers), Ltd., J. R.
E. N. V. Engineering Co., Ltd.
Gear Grinding Co., Ltd., The
Graseby Instruments, Ltd.
Opperman, Ltd., S. E.
Rose Brothers (Gainsborough), Ltd.
Rotax, Ltd.
Vactric, Ltd.

GENERATORS, ELECTRIC
Aerocontacts (Sales), Ltd.
British Thomson-Houston Co., Ltd., The
Partridge, Wilson and Co., Ltd.
Petbow, Ltd.
Peto and Radford, Ltd.
Ross, Ltd., S. Grahame
Venner Accumulators, Ltd.
Vernons Industries, Ltd.
Westinghouse Brake and Signal Co., Ltd.

GUNS.—see Armament

GYRO INSTRUMENTS
Aerocontacts (Sales), Ltd.
Brown, Ltd., S. G.
Elliott Brothers (London), Ltd.
E.M.O. Instrumentation, Ltd.
Ferranti, Ltd.
Graseby Instruments, Ltd.
Honeywell-Brown, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.
Wynnstruments, Ltd.

HAIR, RUBBERIZED
(for Packaging, upholstery, etc.)
Cox and Son, Ltd., John
Expanded Rubber Co., Ltd.
Hairlok, Co., Ltd., The
Latex Upholstery, Ltd.
Microcell, Ltd.
Rumbold and Co., Ltd., L. A.
Xetal Products, Ltd.

HANDLING EQUIPMENT, AIRCRAFT
(other than tractors)
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Brown Brothers (Aircraft), Ltd.
Clapham Park Motors, Ltd.
Dart Aircraft, Ltd.
Lansing Bagnall, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Mercury Truck and Tractor Co., Ltd., The
Pipework and Engineering (Bristol), Ltd.
Ross, Ltd., S. Grahame.
Vernons Industries, Ltd.

HANGARS
Aerocontacts (Ground Equipment), Ltd.
British Insulated Callender's Cables, Ltd.
Constain, Ltd., Richard
Coseley Engineering Co., Ltd., The
Hawkaley S. M. D., Ltd.

HANGARAGE
Aviation Traders (Engineering), Ltd.
Coseley Engineering Co., Ltd., The
Derby Aviation, Ltd.

HARNESSES, AIRCREW
Aerocontacts (Sales), Ltd.
Field Aircraft Services, Ltd.
G. Q. Parachute Co., Ltd.
Irving Air Chute of Great Britain, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Newton and Co., H. T.
Rumbold and Co., Ltd., L. A.
Stewart Aeronautical Supply Co., Ltd.

HEATERS, AIRCRAFT
Delaney Gallay, Ltd.
Dragonair, Ltd.
Field Aircraft Services, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Newton and Co., H. T.
Serck Radiators, Ltd.

HEATERS HANGAR AND FACTORY
Aerocontacts (Ground Equipment), Ltd.
Dragonair, Ltd.
General Electric Co., Ltd., The

HEAT-EXCHANGERS
Delaney Gallay, Ltd.
Dragonair, Ltd.
Hadfields, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Sankey and Sons, Ltd., Joseph
Serck Radiators, Ltd.

HEAT-RESISTANT ALLOYS
(see also Steels; Alloys, ferrous, etc.)
Brown Bayley Steels, Ltd.
Ferro Enamels, Ltd.
Firth-Vickers Stainless Steels, Ltd.
Hadfields, Ltd.
Hall and Pickles, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Low Moor Alloy Steelworks, Ltd.
Mond Nickel Co., Ltd., The
Thermo-Plastics, Ltd.
Wiggin and Co., Ltd., Henry.
Wilson and Sons (London), Ltd.

HEATING EQUIPMENT, INDUSTRIAL PROCESS
Aerocontacts (Ground Equipment), Ltd.
British Thomson-Houston Co., Ltd., The
Dragonair, Ltd.
French and Sons, Ltd., Thomas
General Electric Co., Ltd., The
Philips Electrical, Ltd.

HELICOPTER AGENCIES AND SPARES
Autair, Ltd.
Elliot Equipment, Ltd.
Hordern-Richmond (Sales), Ltd.
Newton and Co., H. T.
Ross, Ltd., S. Grahame

HONEYCOMB, METAL
Aero Research, Ltd.
Roe and Co., Ltd., A. V.

HOSE, FLEXIBLE
Aero Maintenance Equipment, Ltd.
Automotive Products Co., Ltd.
Avery-Hardoll, Ltd.
Avica Equipment, Ltd.
B.X. Plastics, Ltd.
Bell's Asbestos and Engineering, Ltd.
Boorn and Co., Ltd., Thomas
Bowden Engineers, Ltd.
Clapham Park Motors, Ltd.
Dunlop Rubber Co., Ltd.
Gabriel Manufacturing Co., Ltd.
Hall and Hall, Ltd.
Kautex, Ltd.
King Aircraft Corporation
Maricon, Ltd.
Palmer Tyre, Ltd., The
Peradin and Watercraft, Ltd.
Power Auxiliaries, Ltd.
Skyhi, Ltd.
Siebe, Gorman and Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Wilkinson Rubber Linatex, Ltd.

HYDRAULIC EQUIPMENT
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Avica Equipment, Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Clapham Park Motors, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Exactor, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.
High Pressure Components, Ltd.
Hobson, Ltd., H. M.
I.V. Pressure Controllers, Ltd.
Integral, Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Pipework and Engineering (Bristol), Ltd.
Power Jacks, Ltd.
Reilly Engineering, Ltd.
Skyhi, Ltd.
Sperry Gyroscope Co., Ltd.
Trist and Co., Ltd., Ronald
Western Manufacturing (Reading), Ltd.
Wilmot Breeden, Ltd.

IGNITION EQUIPMENT
Avica Equipment, Ltd.
British Thomson-Houston Co., Ltd., The
Eastern Aero Electrical Services, Ltd.
Hants and Sussex Aviation, Ltd.
K.L.G. Sparking Plugs, Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Rotax, Ltd.
Whittemore (Aeradio), Ltd., A. J.

INSPECTION EQUIPMENT
Brent Chemical Products, Ltd.
Engineering Products, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Newton and Co., H. T.
Optical Measuring Tools, Ltd.
Precision Diamond Products, Ltd.
R.P.R. Patents, Ltd.

INSTRUMENTS, AIRCRAFT AND NAVIGATIONAL
Aerocontacts (Sales), Ltd.
Aldis Brothers, Ltd.
Avimo, Ltd.
Brown, Ltd., S. G.
Cossor, Ltd., A. C.
Dent and Co. and Johnson, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Kent, Ltd., George
Kontak Manufacturing Co., Ltd.
Munro, Ltd. R. W.
Murphy Radio, Ltd.
Negretti and Zambra, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Rose Brothers (Gainsbroough), Ltd.
Salford Electrical Instruments, Ltd.
Sangamo Weston, Ltd.
Simmonds Aerocessories, Ltd.
Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.
Wynnstruments, Ltd.

INSULATION, ELECTRICAL
Bakelite, Ltd.
British Thomson-Houston Co., Ltd.
Crane Packing, Ltd.
Ferranti, Ltd.
Fibreglass, Ltd.
Fothergill and Harvey (Sales), Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
Imperial Chemical Industries, Ltd.
Precision Rubbers, Ltd.

(*Continued on page* 411)

Solo or dual...

unrivalled for aircraft cabin furnishing

Connolly
LEATHER
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UPHOLSTERY MATERIAL

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MORE RELIABLE
LIGHTER
COOLER RUNNING

THIS LATEST DEVELOPMENT ALSO MEANS THE END OF TUBE TROUBLES

Here are the aircraft tyres of the future – Goodyear Tubeless. Specify them *now*. They set a completely new standard of tyre safety, offering greatest-yet protection against sudden bursts during today's high-speed landings and take-offs.

Of equal importance, these new tyres save weight. The amount saved per aircraft depends, of course, on the size, type and number of wheels. It can amount to as much as 94 lbs. on multiple-wheel aircraft.

Goodyear Tubeless Aircraft Tyres eliminate all tube and valve problems and are cooler running than ordinary tyres. There's no troublesome job of fitting the tubes in the casing and the valve is made an integral part of the wheel.

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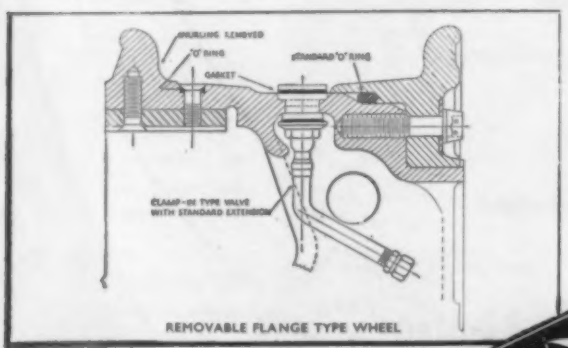
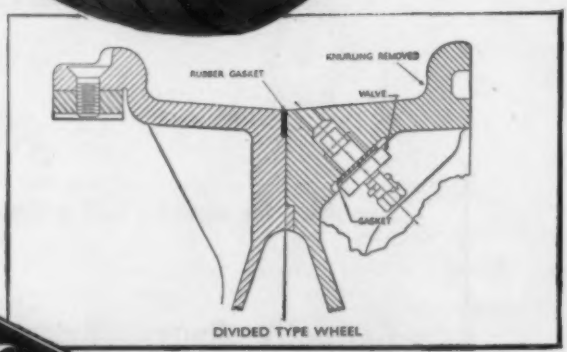


REMOVABLE FLANGE TYPE WHEEL



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THE ANCILLARY INDUSTRY . . .

Insulation, Electrical (Continued)

Rist's Wires and Cables, Ltd.
Standard Insulator Co., Ltd., The
St. Helens Cable and Rubber Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Tufnol, Ltd.
Turner Brothers Asbestos Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wills Pressure Filled Joint Ring, Ltd.

INSULATION, SOUND

Anticoustic Co., The
Cementation (Muffelite), Ltd.
Cullum and Co., Ltd., Horace W.
Delaney Gallay, Ltd.
Detuners, Ltd.
Fibreglass, Ltd.
Jablo Plastics Industries, Ltd.
Rumbold and Co., Ltd., L. A.
Standard Insulator Co., Ltd., The
Thermo-Plastics, Ltd.

INSULATION, THERMAL

B. X. Plastics, Ltd.
Bell's Asbestos and Engineering, Ltd.
Burgess and Co., Ltd., G. H.
Burnley Aircraft Products, Ltd.
Delaney Gallay, Ltd.
Expanded Rubber Co., Ltd.
Fibreglass, Ltd.
Jablo Plastics Industries, Ltd.
Rumbold and Co., Ltd., L. A.
Standard Insulator Co., Ltd., The
Thermo-Plastics, Ltd.
Turner Brothers Asbestos Co., Ltd.

INSURANCE

Aviation Traders, Ltd.
British Aviation Insurance Co., Ltd., The
Derby Aviation, Ltd.

JACKS, AIRCRAFT COMPONENT

Aero Controls, Ltd.
Aero Maintenance Equipment, Ltd.
British Messier, Ltd.
Clapham Park Motors, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Exactor, Ltd.
Fairey Aviation Co., Ltd., The
Hymatic Engineering Co., Ltd., The
Leytonstone Jig and Tool Co., Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Palmer Tyre, Ltd., The
Power Jacks, Ltd.
Reilly Engineering, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Trist and Co., Ltd., Ronald
Western Manufacturing (Reading), Ltd.
Westminster Airways Servicing, Ltd.

JACKS (LIFTING, FOR MAINTENANCE, ETC.)

Aero Controls, Ltd.
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Brown Brothers (Aircraft), Ltd.
Clapham Park Motors, Ltd.
Eagle Aircraft Services, Ltd.
Exactor, Ltd.
Field Aircraft Services, Ltd.
H.M.L. (Engineering), Ltd.
Hobson, Ltd., H. M.
Leytonstone Jig and Tool Co., Ltd.
Opperman, Ltd., S. E.
Power Jacks, Ltd.
Reilly Engineering, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Skyhi, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Trist and Co., Ltd., Ronald

JIGS AND FIXTURES

Abbey Panel and Sheet Metal Co., Ltd., The
Aerocontacts (Ground Equipment), Ltd.
Attewell and Sons, Ltd., B.
Aviation Traders (Engineering), Ltd.
Avimo, Ltd.
Burgess and Co., Ltd., G. H.
Cornercroft, Ltd.
Dancer and Hearne Bros., Ltd.
Fairey Aviation Co., Ltd., The
Gloster Engineering (Cheltenham), Ltd.
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Jameson, Ltd., J. L.
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Spa Guilds, Ltd.
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Vactric, Ltd.
Westminster Airways Servicing, Ltd.
Wilmot Breeden, Ltd.

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Engineering Products, Ltd.
Mining and Chemical Products, Ltd.
Purefoy Unit Tooling, Ltd., J. B.
Ross, Ltd., S. Grahame

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Boorn and Co., Ltd., Thomas
British Belting and Asbestos, Ltd.
British Paints, Ltd.
Cellon, Ltd.
Clapham Park Motors, Ltd.
Coopers Mechanical Joints, Ltd.
Crane Packing, Ltd.
Dowty Seals, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Hall and Hall, Ltd.
Hellermann, Ltd.
Henley's Wireless Telegraph Co., Ltd., W. T.
Kautex, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Leytonstone Jig and Tool Co., Ltd.
Palmer Tyre, Ltd., The
Rawlplug Co., Ltd., The
Ryland, Ltd., Llewellyn
Standard Insulator Co., Ltd., The
Super Oil Seals and Gaskets, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Titanine, Ltd.
Trist and Co., Ltd., Ronald
Turner Brothers Asbestos Co., Ltd.
Walker and Co., Ltd., James
Wellworthy, Ltd.
Wilkinson Rubber Linatex, Ltd.

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Amal, Ltd.
Avica Equipment, Ltd.
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Hardy Spicer, Ltd.
I.V. Pressure Controllers, Ltd.
Laycock Engineering, Ltd.
Mollart Engineering Co., Ltd., The

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Bryans Aeroquipment, Ltd.
Elliott Brothers (London), Ltd.
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
I.V. Pressure Controllers, Ltd.
Measuring Instruments (Pullin), Ltd.
Muirhead and Co., Ltd.
Rose Brothers (Gainsborough), Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.

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British Messier, Ltd.
Dowty Equipment, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Opperman, Ltd., S. E.
Vickers-Armstrongs (Aircraft), Ltd.

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Elliot Equipment, Ltd.
Expanded Rubber Co., Ltd.
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Lea Bridge Industries, Ltd.
R.F.D. Co., Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

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Aircraft Materials, Ltd.
Burgess and Co., Ltd., G. H.
Burndept, Ltd.
Easco Electrical (Holdings), Ltd.
Elliot Equipment, Ltd.
Expanded Rubber Co., Ltd.
Frankenstein and Sons (Manchester), Ltd., P.
Irving Air Chute of Great Britain, Ltd.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., Walter, The
Lea Bridge Industries, Ltd.
M. L. Aviation Co., Ltd.
Martin-Baker Aircraft Co., Ltd.
Peradin and Watercraft, Ltd.
R.F.D. Co., Ltd.
Schermuly Pistol Rocket Apparatus, Ltd., The
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Ultra Electric, Ltd.

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Aeronautical Trades and Manufacturing Co., Ltd.
British Thomson-Houston Co., Ltd., The
Easco Electrical (Holdings), Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Harley Aircraft Landing Lamps
Newton and Co., H. T.
Philips Electrical, Ltd.
Rotax, Ltd.
Scottish Aviation, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Suntex Safety Glass Industries, Ltd.
Thorn Electrical Industries, Ltd.
Venner Accumulators, Ltd.
Venner, Ltd.

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Aerocontacts (Ground Equipment), Ltd.
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British Thomson-Houston Co., Ltd. The
City Electrical Co.
Easco Electrical (Holdings), Ltd.
Eastern Aero Electrical Services, Ltd.
General Electric Co., Ltd., The
Harley Aircraft Landing Lamps
International Aeradio, Ltd.
Philips Electrical, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thorn Electrical Industries, Ltd.

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C.W.C. Equipment, Ltd.
City Electrical Co.
General Electric Co., Ltd., The
Philips Electrical, Ltd.
Suntex Safety Glass Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Terry and Sons, Ltd., Herbert.
Thorn Electrical Industries, Ltd.

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Aircraft Materials, Ltd.
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Aeronautical Trades and Manufacturing Co., Ltd.
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Whitehouse Industries, Ltd.

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King Aircraft Corporation
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Thompson Bros. (Bilston), Ltd.
Wakefield and Co., Ltd., C. C.

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Field Aircraft Services, Ltd.
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Hants and Sussex Aviation, Ltd.
Newton and Co., H. T.
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Hunting Aerosurveys, Ltd.
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Microcell, Ltd.
R.F.D. Co., Ltd.
Samlesbury Engineering, Ltd.
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Vosper, Ltd.

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Partridge, Wilson and Co., Ltd.
Ross, Ltd., S. Grahame
Skyhi, Ltd.
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General Electric Co., Ltd., The
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Hobson, Ltd., H. M.
Honeywell-Brown, Ltd.
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Marston Excelsior, Ltd.
Murphy Radio, Ltd.
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Newmark, Ltd., Louis
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Opperman, Ltd., S. E.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Reilly Engineering, Ltd.
Rolls Razor, Ltd.
Samlesbury Engineering, Ltd.
Southern Instruments, Ltd.
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Standard Insulator Co., Ltd., The
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Vactric, Ltd.
Venner Accumulators, Ltd.
Vickers-Armstrongs (Aircraft), Ltd.

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Suntex Safety Glass Industries, Ltd.
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Aerocontacts (Sales), Ltd.
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City Electrical Co.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
General Electric Co., Ltd., The
Newton and Co., H. T.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Rotol, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vactric, Ltd.
Western Manufacturing (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Dunlop Rubber Co., Ltd.
Fairey Aviation Co., Ltd., The
Newton and Co., H. T.
Opperman, Ltd., S. E.
Peradin and Watercraft, Ltd.
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Silentbloc, Ltd.
Stewart Aeronautical Supply Co., Ltd.
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Cullum and Co., Ltd., Horace W.
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Cossor, Ltd., A. C
Decca Navigator Co., Ltd., The
Decca Radar, Ltd.
E.R.S. (London), Ltd.
Ekco Electronics, Ltd.
International Aeradio, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Lancefield Aircraft Components, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
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Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
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V.P. Sheet Metal, Ltd.

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Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
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British Oxygen Gases, Ltd.
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Lewis, Ltd., D.
Newton and Co., H. T.
Normalair, Ltd.
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Park, Ltd., R. and J.
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Hairlok Co., Ltd., The
Jablo Plastics Industries, Ltd.
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Reynolds (Packaging), Ltd.
Rose Brothers (Gainsborough), Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

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Cellon, Ltd.
Docker Brothers
Hall and Sons (Bristol and London). Ltd., John
Imperial Chemical Industries, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Modern Industrial Finishes, Ltd.
Ryland, Ltd., Llewellyn
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Vulcan Products, Ltd.

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British Paints, Ltd.
Cellon, Ltd.

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Hall and Sons (Bristol and London), Ltd., John
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Elliot Equipment, Ltd.
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Avimo, Ltd.
Brown Brothers (Aircraft), Ltd.
Burgess and Co., Ltd., G. H.
Cornercroft, Ltd.
Engineering Products, Ltd.
Fairey Aviation Co., Ltd., The
Jameson, Ltd., J. L.
Jameson Aero Engines, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Miles, Ltd., F. G.
Opperman, Ltd., S. E.
Plessey Co., Ltd., The
R.F.D. Co., Ltd.,
Rollason Aerocessories, Ltd.
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Rumbold and Co., Ltd., L. A.
Rushton Engineering Co., Ltd.
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Spa Guilds, Ltd.
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Westminster Airways Servicing, Ltd.
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Yorkshire Engineering Supplies, Ltd.

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Brown Brothers (Aircraft), Ltd.
Burgess and Co., Ltd., G. H.
Eagle Aircraft Services, Ltd.
Lancefield Aircraft Components, Ltd.
Pipework and Engineering (Bristol), Ltd.
Reynolds Tube Co., Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
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Meridian Airmaps, Ltd.
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General Electric Co., Ltd., The
Plessey Co., Ltd., The
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Saro Laminated Wood Products, Ltd.

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Jablo Plastics Industries, Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
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PLASTICS, EXTRUSIONS
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Crane Packing, Ltd.
Heilermann, Ltd.
Miles, Ltd., F. G.
Rists Wires and Cables, Ltd.
St. Helens Cable and Rubber Co., Ltd.
Saro Laminated Wood Products, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

PLASTICS, FABRICATED
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Aston and Co., Ltd., E. S.
Attewell and Sons, Ltd., B.
Burgess and Co., Ltd., G. H.
Crane Packing, Ltd.
Fairey Aviation Co., Ltd., The
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
M.L. Aviation Co., Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Parnall and Co., Ltd., George
St. Helens Cable and Rubber Co., Ltd.
Saro Laminated Wood Products, Ltd.
Suntex Safety Glass Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Uhlhorn Bros., Ltd.
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PLASTICS, GLASS FIBRE
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Burgess and Co., Ltd., G. H.
Crane Packing, Ltd.
Dart Aircraft, Ltd.
Ferro Enamels, Ltd.
Hordern-Richmond (Sales), Ltd.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., Walter, The
King Aircraft Corporation
Microcell, Ltd.
Miles, Ltd., F. G.
St. Helens Cable and Rubber Co., Ltd.
Saro Laminated Wood Products, Ltd.
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Thermo-Plastics, Ltd.
Turner Brothers Asbestos Co., Ltd.

PLASTICS, LAMINATED
Aeroplastics, Ltd.
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Bakelite, Ltd.
Brand and Co., Ltd., R. A.
British Paints, Ltd.
Dart Aircraft, Ltd.
Hordern-Richmond (Sales), Ltd.
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Microcell, Ltd.
Miles, Ltd., F. G.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
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Tufnol, Ltd.
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Wills Pressure Filled Joint Ring, Ltd.

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Attewell and Sons, Ltd., B.
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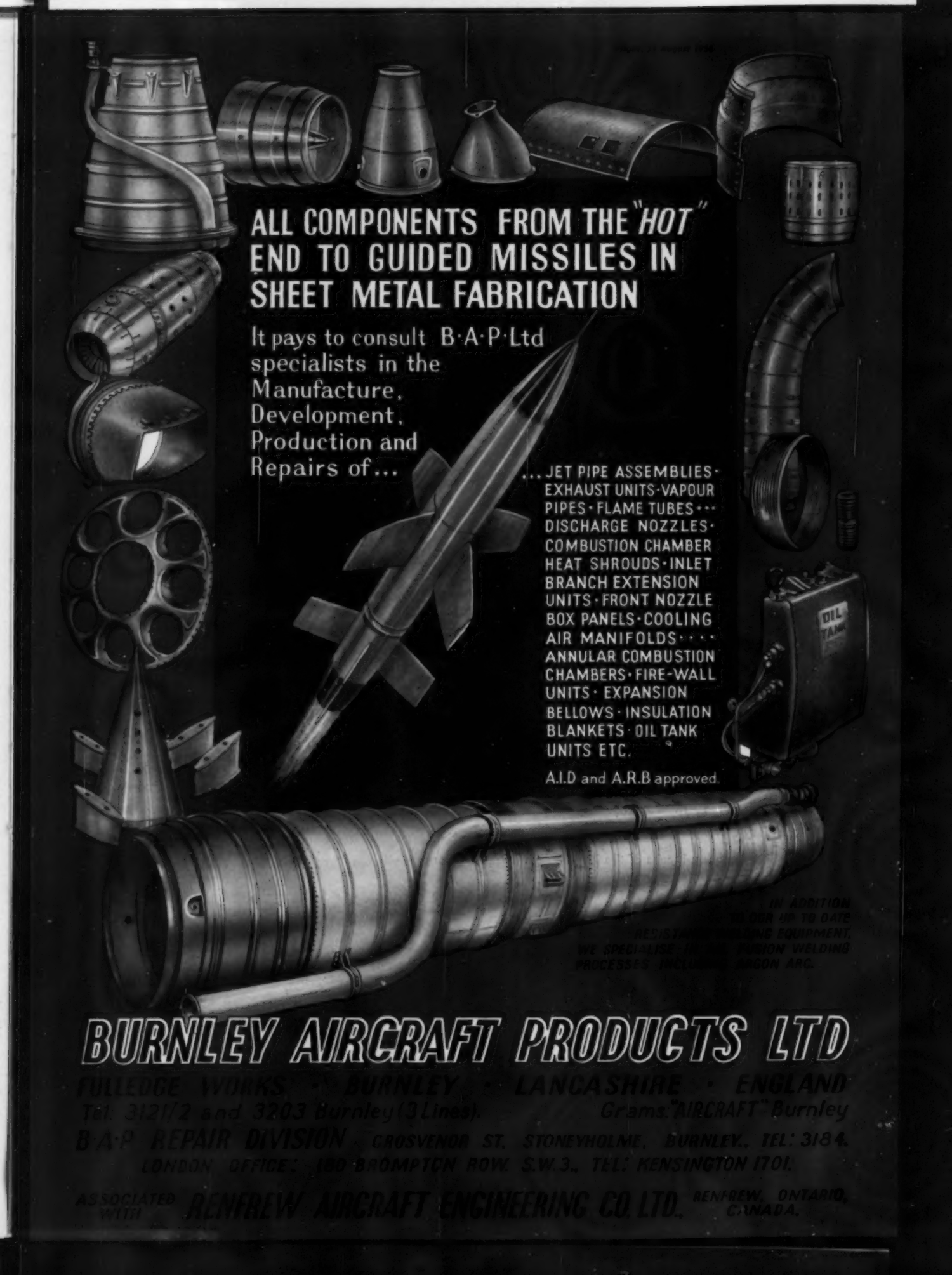
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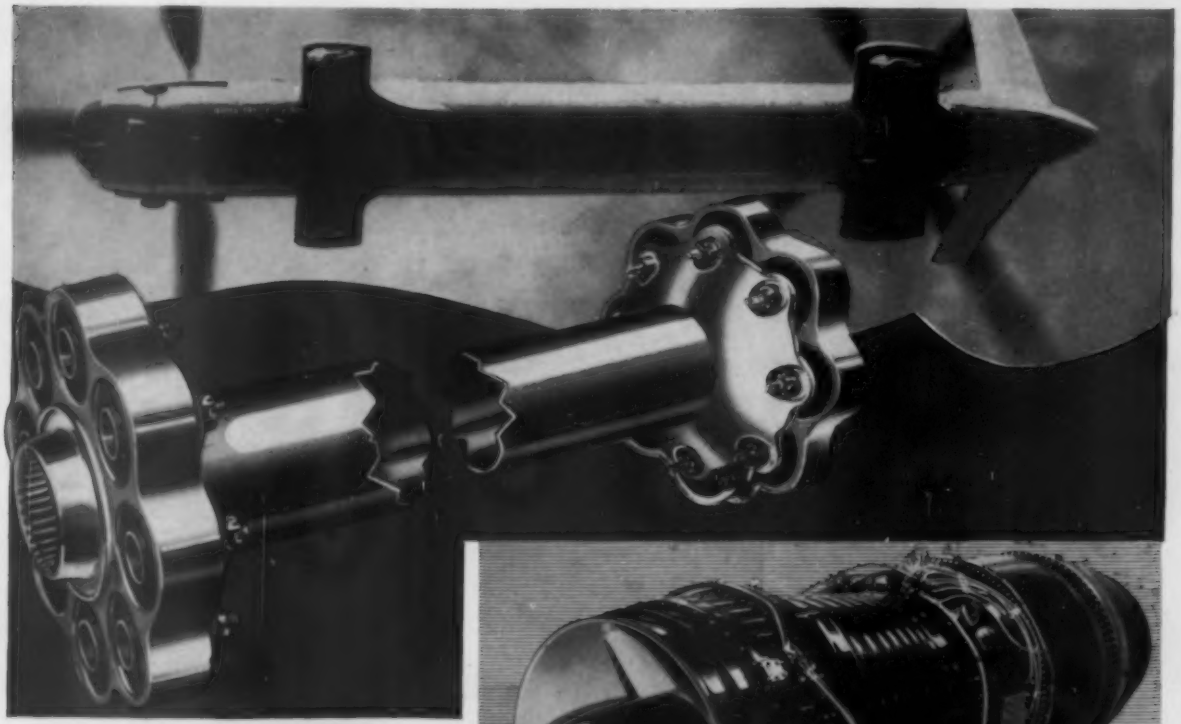

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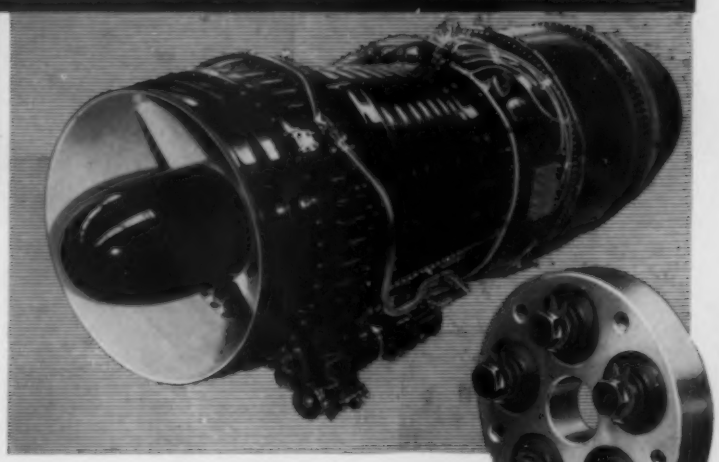

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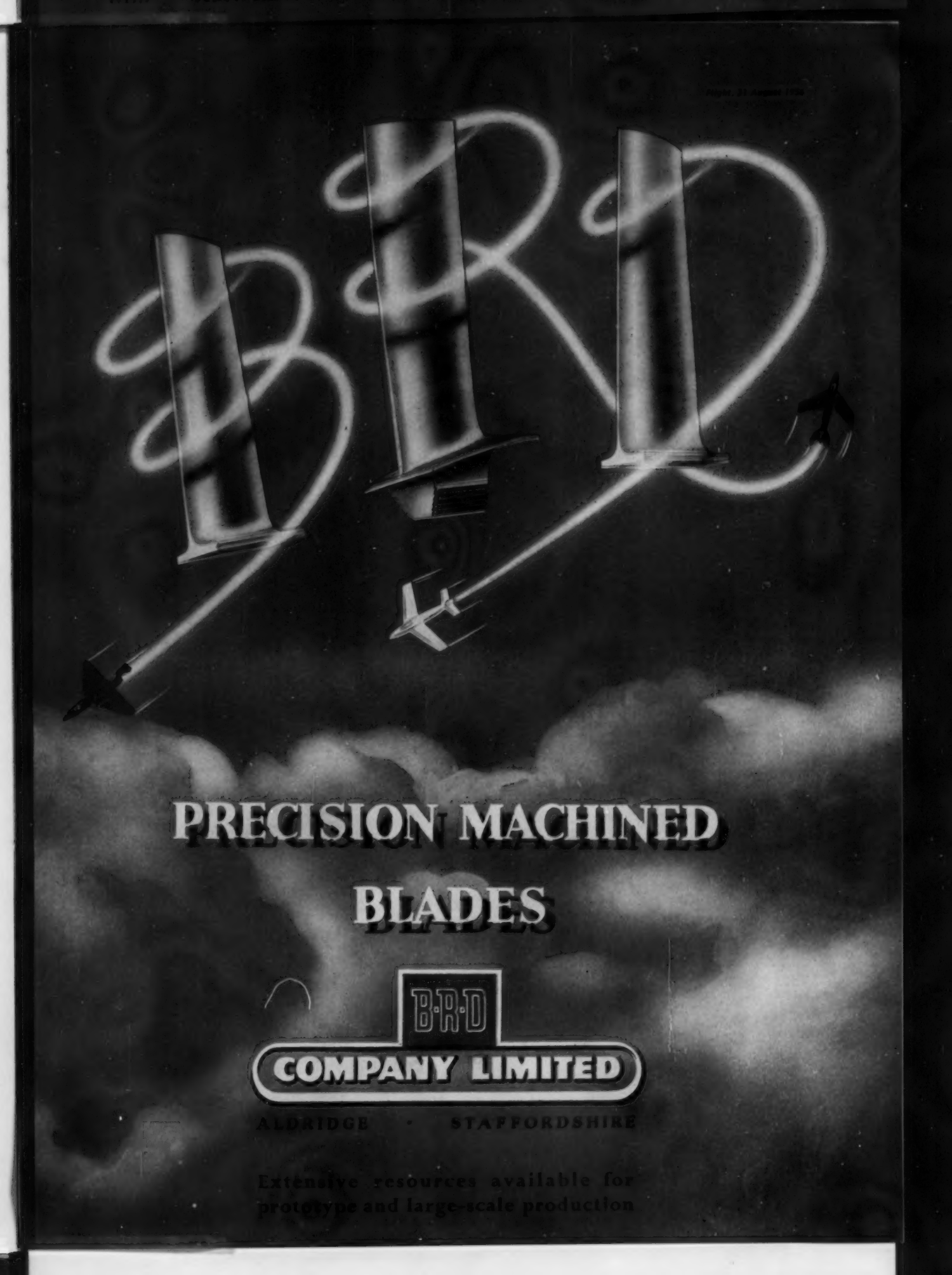
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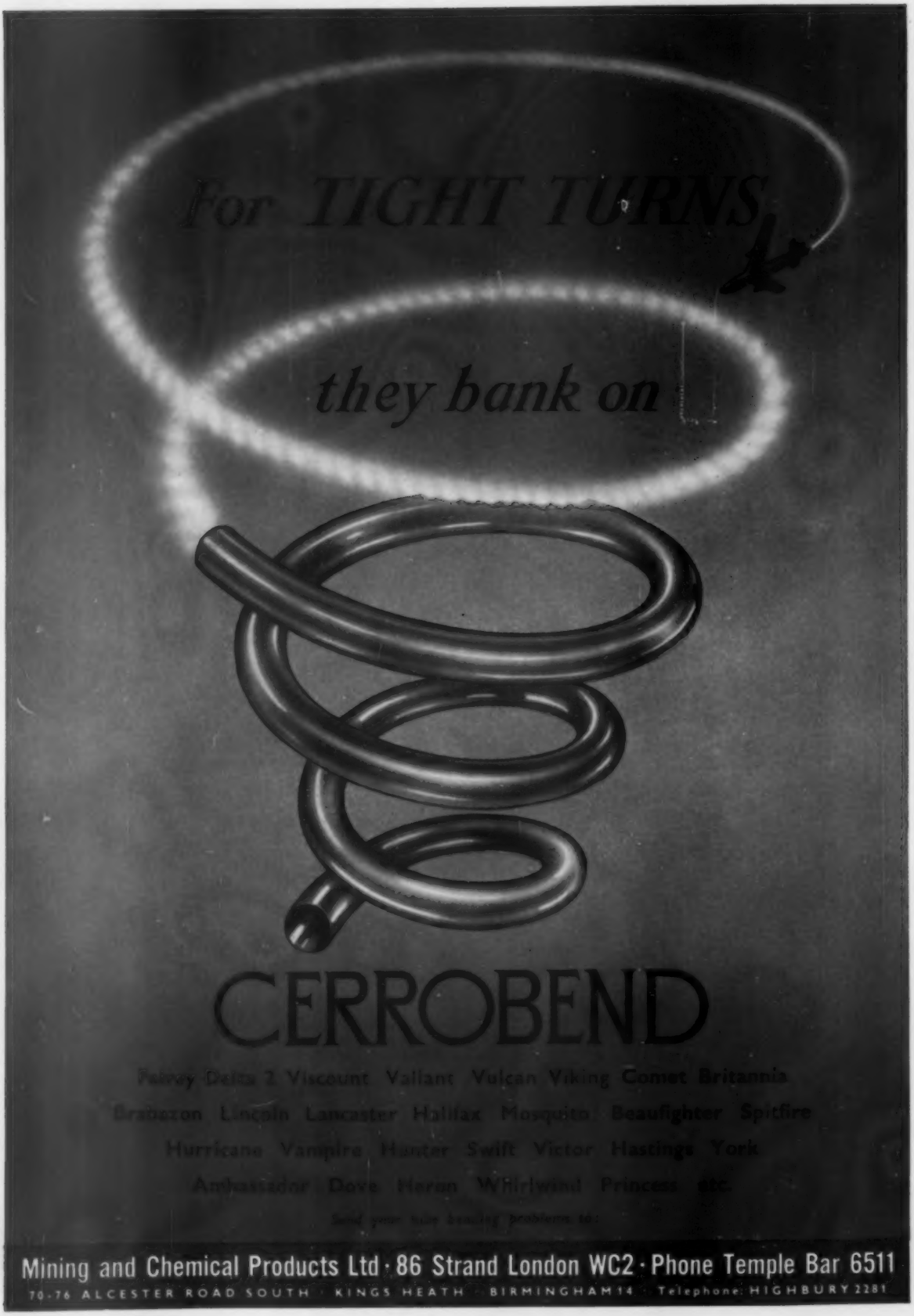
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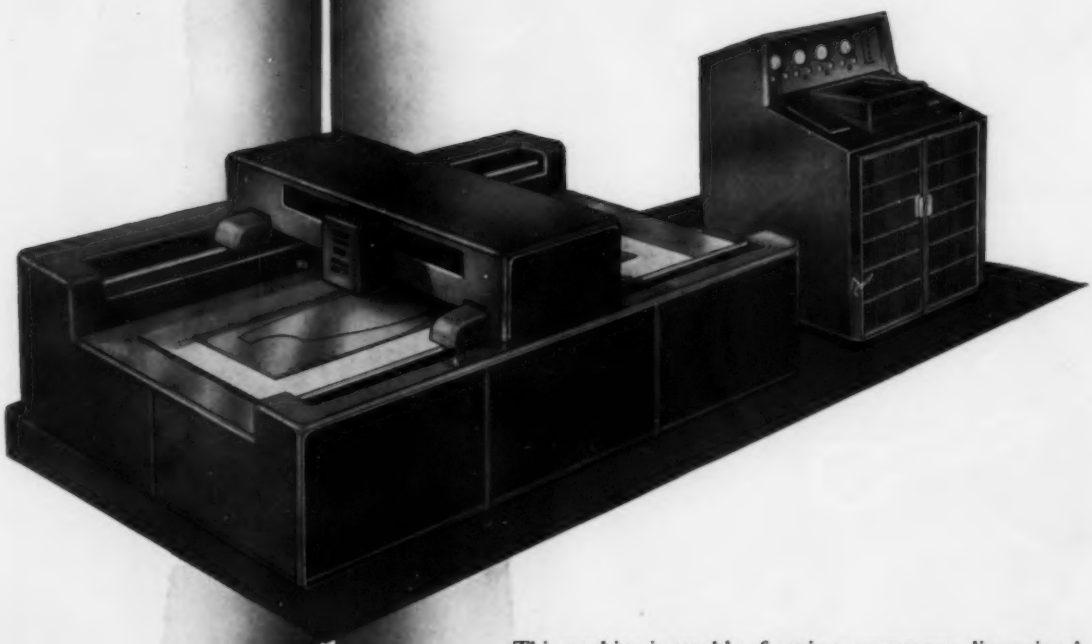

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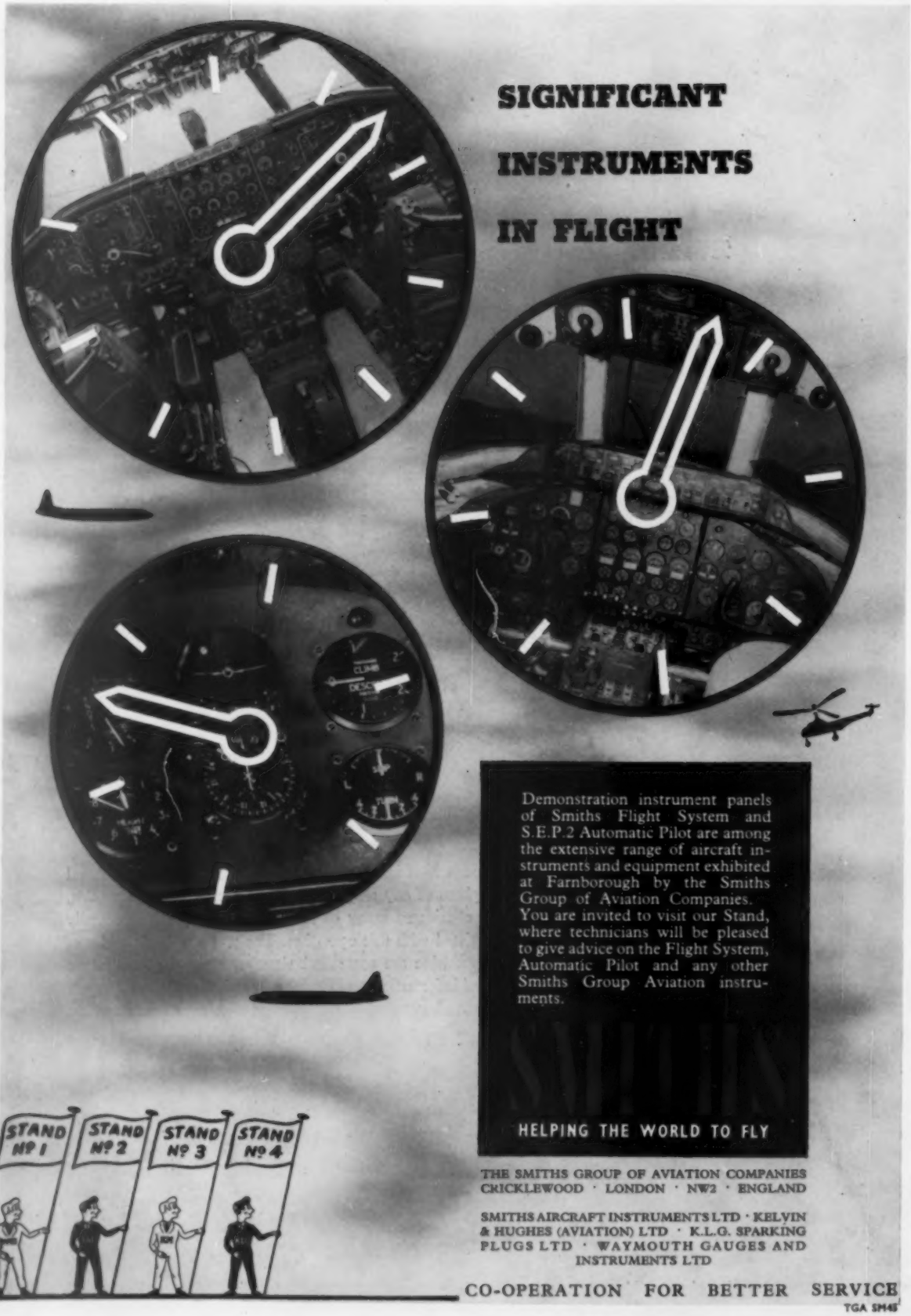
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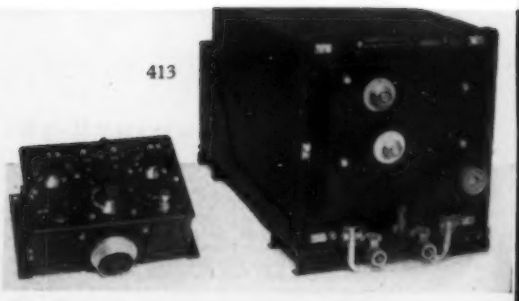

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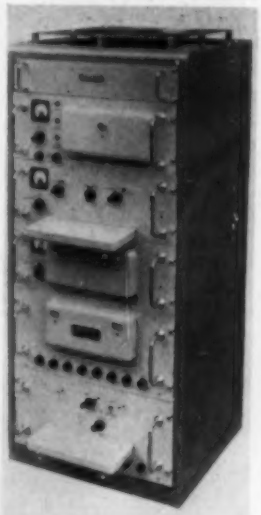

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Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Samlesbury Engineering, Ltd.
Shackleton, Ltd., W. S.
Skyways, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Y.S.C., Ltd., The

SPRAYING EQUIPMENT (for paint, etc.)
Atlas Copco (Great Britain), Ltd.
Copco (Great Britain), Ltd.
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.

SPRINGS
Fox and Co., Ltd., Samuel
Riley, Ltd., Robert
Salter and Co., Ltd., Geo.
Terry and Sons, Ltd., Herbert

STABILIZERS, AUTOMATIC
Elliott Brothers (London), Ltd.
Newmark, Ltd., Louis

STAGINGS, PLATFORMS, ETC., ASSEMBLY AND MAINTENANCE
Aero Controls, Ltd.
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Clapham Park Motors, Ltd.
Opperman, Ltd., S. E.
Ross, Ltd., S. Grahame
Samlesbury Engineering, Ltd.

STANDS, ENGINE
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Burgess and Co., Ltd., G. H.
Clapham Park Motors, Ltd.
Eccles (Birmingham), Ltd.
Lansing Bagnall, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M. L. Aviation Co., Ltd.
Pipework and Engineering (Bristol), Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Samlesbury Engineering, Ltd.

STEELS, AIRCRAFT (see also Alloys, ferrous, etc.)
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Brown Bayley Steels, Ltd.
Carlisle and Co., Ltd., C. G.
English Steel Rolling Mills Corporation, Ltd.
Fairey Aviation Co., Ltd., The
Firth and John Brown, Ltd., Thos.
Firth-Vickers Stainless Steels, Ltd.
Flather, Ltd., W. T.
Fox and Co., Ltd., Samuel
Habershon and Sons, Ltd., J. J.
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Low Moor Alloy Steelworks, Ltd.
Rapp, Ltd., Leo
Steel, Peech and Tozer
Talbot Stead Tube Co., Ltd.

STEELS, CORROSION RESISTING (see also Alloys, ferrous, etc.)
Aircraft Materials, Ltd.
Brown Bayley Steels, Ltd.
Carlisle and Co., Ltd., C. G.
Fairey Aviation Co., Ltd., The
Firth-Vickers Stainless Steels, Ltd.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Low Moor Alloy Steelworks, Ltd.
Rapp, Ltd., Leo
Steel, Peech and Tozer
Talbot Stead Tube Co., Ltd.

STEELS, HEAT RESISTING (see also Alloys, ferrous, etc.)
Brown Bayley Steels, Ltd.
Carlisle and Co., Ltd., C. G.
Clapham Park Motors, Ltd.
Fairey Aviation Co., Ltd., The
Firth-Vickers Stainless Steels, Ltd.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Low Moor Alloy Steelworks, Ltd.
Rapp, Ltd., Leo
Steel, Peech and Tozer, Ltd.
Talbot Stead Tube Co., Ltd.

STEPS, AIRCRAFT PASSENGER
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Clapham Park Motors, Ltd.
Dart Aircraft, Ltd.
Derby Aviation, Ltd.
H.M.L. (Engineering), Ltd.
Heston Aircraft Co., Ltd., The
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.

SURVEY, AIR
Derby Aviation, Ltd.
Fairey Air Surveys, Ltd.
Fairey Aviation Co., Ltd., The
Hunting Aerosurveys, Ltd.
Meridian Airmaps, Ltd.

Road - trailer engine stand for Dart, by Aviation Traders (Engineering), Ltd.

SWITCHES, AUTOMATIC AND SPECIAL-PURPOSE
British Thomson-Houston Co., Ltd., The
Burgess Products Co., Ltd.
Dunlop Rubber Co., Ltd.
E.R.S. (London), Ltd.
Graseby Instruments, Ltd.
Honeywell-Brown, Ltd.
Irving Air Chute of Great Britain, Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Thermal Control Co., Ltd.
Trist and Co., Ltd., Ronald
Vactric, Ltd.
Venner, Ltd.

SWITCHES, ELECTRICAL
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
British Thomson-Houston Co., Ltd.
Burgess Products Co., Ltd.
C.W.C. Equipment, Ltd.
Dowty Nucleonics, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
General Electric Co., Ltd., The
Honeywell-Brown, Ltd.
McMichael Radio, Ltd.
Muirhead and Co., Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Trist and Co., Ltd., Ronald
Venner, Ltd.

TANKS, DROP
Abbey Panel and Sheet Metal Co., Ltd., The
Air Service Training, Ltd.
Hickman, Ltd.
Lancefield Aircraft Components, Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Samlesbury Engineering, Ltd.
Saro Laminated Wood Products, Ltd.

TANKS, FUEL AND OIL
Abbey Panel and Sheet Metal Co., Ltd., The
Burnley Aircraft Products, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Fireproof Tanks, Ltd.
Harvey and Co. (London), Ltd., G. A.
Hickman, Ltd.
Lancefield Aircraft Components, Ltd.
Marston Excelsior, Ltd.
Samlesbury Engineering, Ltd.
Taylor (Metal-Workers), Ltd., C. F.
Thompson Bros. (Bilston), Ltd.
Vosper, Ltd.

TAPES, ADHESIVE, MASKING, ETC.
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
B. X. Plastics, Ltd.
Bell's Asbestos and Engineering, Ltd.
Brown Brothers (Aircraft), Ltd.
Cox and Son, Ltd., John
Dalmas, Ltd.
Henley's Wireless Telegraph Co., Ltd., W. T.
Telegraph Construction and Maintenance Co., Ltd., The
Vane and Co., A. H.

TARGETS.—see Training Equipment

TEMPERATURE-SENSITIVE EQUIPMENT
Honeywell-Brown, Ltd.
Philips Electrical, Ltd.
Sangamo Weston, Ltd.
Steel and Co., Ltd., J. M.
Stone and Co. (Deptford), Ltd., J.
Teddington Aircraft Controls, Ltd.

TERMINALS
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Aircraft Marine Products (Great Britain), Ltd.
Belling and Lee, Ltd.
Brown Brothers (Aircraft), Ltd.
Eastern Aero Electrical Services, Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Ross, Courtney and Co., Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

TEST EQUIPMENT, AERODYNAMIC
British Communications Corporation, Ltd.
E.R.S. (London), Ltd.
Fairey Aviation Co., Ltd., The
Heston Aircraft Co., Ltd., The
Newton and Co., H. T.
Savage and Parsons, Ltd.
Test Equipment, Ltd.
Test Equipment (Models), Ltd.

TEST EQUIPMENT, ELECTRICAL AND ELECTRONIC
Aerocontacts (Ground Equipment), Ltd.
Aeronautical Radio Services, Ltd.
Automatic Coil Winder and Electrical Equipment Co., Ltd., The
Avimo, Ltd.
Boulton Paul Aircraft, Ltd.
British Thomson-Houston Co., Ltd., The
Bryans Aeroquipment, Ltd.
Burndept, Ltd.
City Electrical Co.
Cossor, Ltd., A. C.
Decca Radar, Ltd.
Dowty Nucleonics, Ltd.
E. R. S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Easco Electrical (Holdings), Ltd.
Elliott Brothers (London), Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Fonadek (Branson), Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
Hobson, Ltd., H. M.
International Aeradio, Ltd.
Kent, Ltd., George
M. L. Aviation Co., Ltd.
Marconi Instruments, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Muirhead and Co., Ltd.
Mullard, Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Philips Electrical, Ltd.
Pye, Ltd.
Racal Engineering, Ltd.
Reid and Sigrist, Ltd.
Reilly Engineering, Ltd.
Rose Brothers (Gainsborough), Ltd.
Rotax, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Sangamo Weston, Ltd.
Savage and Parsons, Ltd.
Saunders-Roe, Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wynnstruments, Ltd.

TEST EQUIPMENT, HYDRAULIC
Aerocontacts (Ground Equipment), Ltd.
Dowty Equipment, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
H. M. L. (Engineering), Ltd.
Hobson, Ltd., H. M.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Lockheed Hydraulic Brake Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Pipework and Engineering (Bristol), Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Skyhi, Ltd.
Southern Instruments, Ltd.
Wilmot-Breeden, Ltd.

TEST EQUIPMENT, INSTRUMENT
Aerocontacts (Ground Equipment), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Automatic Coil Winder and Electrical Equipment Co., Ltd., The
Bryans Aeroquipment, Ltd.
Dawe Instruments, Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Goodmans Industries, Ltd.

Continued overleaf

THE ANCILLARY INDUSTRY . . .

Test Equipment, Instrument (continued)

Graseby Instruments, Ltd.
Honeywell-Brown, Ltd.
I. V. Pressure Controllers, Ltd.
Integral, Ltd.
Kent, Ltd., George
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Rollason Aerocessories, Ltd.
Rose Brothers (Gainsborough), Ltd.
Sanders (Electronics), Ltd., W. H.
Sangamo Weston, Ltd.
Simmonds Aerocessories, Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Wayne Kerr Laboratories, Ltd., The
Wynnstruments, Ltd.

TEST EQUIPMENT, LABORATORY

Aerocontacts (Ground Equipment), Ltd.
Automatic Coil Winder and Electrical Equipment Co., Ltd., The
British Communications Corporation, Ltd.
Dawe Instruments, Ltd.
Fairey Aviation Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
I. V. Pressure Controllers, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Manchester Oil Refinery (Sales), Ltd.
Muirhead and Co., Ltd.
Newton and Co., H. T.
Rollason Aerocessories, Ltd.
Rose Brothers (Gainsborough), Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Test Equipment, Ltd.
Wayne Kerr Laboratories, Ltd., The

TEST EQUIPMENT, MECHANICAL

Abbey Panel and Sheet Metal Co., Ltd., The
Aerocontacts (Ground Equipment), Ltd.
City Electrical Co.
Curran, Ltd., John
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
H.M.L. (Engineering), Ltd.
Jameson, Ltd., J. L.
Jig Design Co., The
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Newton and Co., H. T.
Optical Measuring Tools, Ltd.
Rollason Aerocessories, Ltd.
Rose Brothers (Gainsborough), Ltd.
Ross, Ltd., S. Grahame
Southern Instruments, Ltd.
Teleflex Products, Ltd.
Test Equipment, Ltd.
Tiltman Langley, Ltd.
Wilmot Breeden, Ltd.

TEST EQUIPMENT, METALLURGICAL

Aerocontacts (Ground Equipment), Ltd.
Manchester Oil Refinery (Sales), Ltd.
Newton and Co., H. T.
R.P.R. Patents, Ltd.
Southern Instruments, Ltd.

TEST EQUIPMENT, PNEUMATIC

Aerocontacts (Ground Equipment), Ltd.
Electro-Hydraulics, Ltd.
Godfrey and Partners, Ltd., Sir George
Hymatic Engineering Co., Ltd.
I. V. Pressure Controllers, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Newton and Co., H. T.
Rollason Aerocessories, Ltd.
Williams and James (Engineers), Ltd.
Wilmot Breeden, Ltd.

TEST-BED INSTALLATIONS, COMPLETE

Aerocontacts (Ground Equipment), Ltd.
Cullum and Co., Ltd., Horace W.
Curran, Ltd., John
Detuners, Ltd.
Heenan and Froude, Ltd.
I. V. Pressure Components, Ltd.
Rover Gas Turbines, Ltd.

THREAD INSERTS

Armstrong Patents Co., Ltd.

TIMING DEVICES

Boulton Paul Aircraft, Ltd.
British Thomson-Houston Co., Ltd., The
G.Q. Parachute Co., Ltd.
Graseby Instruments, Ltd.
Muirhead and Co., Ltd.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Teddington Aircraft Controls, Ltd.
Venner, Ltd.

TITANIUM

Hughes-Johnson Stampings, Ltd., The
Imperial Chemical Industries, Ltd.
Jessop and Sons, Ltd., William
Laporte Chemicals, Ltd.
Reynolds Tube Co., Ltd.

TOE STRAPS, CONTROL

Palmer Tyre, Ltd., The

TOILET EQUIPMENT, AIRCRAFT

Aerocontacts (Ground Equipment), Ltd.
Aerocontacts (Sales), Ltd.
Air Service Training, Ltd.
Cornercroft, Ltd.
Delaney Gallay, Ltd.
Field Aircraft Services, Ltd.
Rumbold and Co., Ltd., L. A.

TOOLS, CUTTING

British Thomson-Houston Co., Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Murex Welding Processes, Ltd.

TOOLS, ENGINEERS' HAND

Acratork Engineering Co., Ltd.
Aerocontacts (Ground Equipment), Ltd.
English Steel Tool Corporation, Ltd.
Garringtons, Ltd.
Jenks Brothers, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Rawlplug Co., Ltd., The
Standard Insulator Co., Ltd., The
Telegraph Construction and Maintenance Co., Ltd., The
Tipping and Co., Ltd., C. R.

TOOLS, MACHINE

Aerocontacts (Ground Equipment), Ltd.
Engineering Products, Ltd.
Gear Grinding Co., Ltd., The
Jameson Aero Engines, Ltd.
Jameson, Ltd., J. L.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd., The
Van Moppes and Sons (Diamond Tools), Ltd., L. M.

TOOLS, PORTABLE POWER

Aerocontacts (Ground Equipment), Ltd.
Atlas Copco (Great Britain), Ltd.
Black and Decker, Ltd.
Desoutter Brothers, Ltd.
Flexible Drives (Gilmans), Ltd.
Morris, Ltd., B. O.
Rawlplug Co., Ltd., The

TOOLS, PRESS

Attewell and Sons, Ltd., B.
Dancer and Hearne Bros., Ltd.
Gloster Engineering (Cheltenham), Ltd.
Hordern-Richmond (Sales), Ltd.
Jig Design Co., The
Leytonstone Jig and Tool Co., Ltd.
Miles, Ltd., F. G.
Plessey Co., Ltd., The
Riley, Ltd., Robert
Thompson (Engineers), Ltd., Raymond F.
Vactric, Ltd.

TOOLS, RIVETING

Aerocontacts (Ground Equipment), Ltd.
Aircraft Materials, Ltd.
Atlas Copco (Great Britain), Ltd.
Aviation Developments, Ltd.
Brown Brothers (Aircraft), Ltd.
Desoutter Brothers, Ltd.
Hymatic Engineering Co., Ltd., The

TOOLS, SPECIAL PURPOSE

Acratork Engineering Co., Ltd.
Aerocontacts (Ground Equipment), Ltd.
Aircraft Marine Products, Ltd.
Desoutter Brothers, Ltd.
Fairey Aviation Co., Ltd., The
Jameson Aero Engines, Ltd.
Jameson, Ltd., J. L.
Jenks Brothers, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd., The
Reilly Engineering, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Staines and Partners, Ltd., J. R.
Standard Insulator Co., Ltd., The
Thompson (Engineers), Ltd., Raymond F.
Vactric, Ltd.
Van Moppes and Sons (Diamond Tools, Ltd., L. M.

TRACTORS, AIRCRAFT.—see also Handling equipment

Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Brown Tractors (Engineering), Ltd., David
Clapham Park Motors, Ltd.
Douglas Equipment, Ltd.
Lansing Bagnall, Ltd.
Mercury Truck and Tractor Co., Ltd., The

TRAINING, AIRCREW

Air Service Training, Ltd.
Brooklands Aviation, Ltd.
Derby Aviation, Ltd.
Skyways, Ltd.

Hymatic remote-control electro-magnetic valve.

TRAINING, TECHNICAL (other than Apprenticeships)

Air Service Training, Ltd.
British Thomson-Houston Co., Ltd., The
Derby Aviation, Ltd.
International Aeradio, Ltd.
Murphy Radio, Ltd.
Power Jets (Research and Development), Ltd.
Siebe, Gorman and Co., Ltd.
Skyways, Ltd.
Solartron Electronic Group, Ltd.

TRAINING EQUIPMENT, AIRCREW

Air Trainers, Ltd.
Elliott Brothers (London), Ltd.
M. L. Aviation Co., Ltd.
Miles, Ltd., F. G.
Redifon, Ltd.
Standard Telephones and Cables, Ltd.
Suchy Holdings, Ltd.

TRAINING EQUIPMENT, ARMAMENT

Brooklands Aviation, Ltd.
Burgess and Co., Ltd., G. H.
Miles, Ltd., F. G.
R. F. D. Co., Ltd.
Ross, Ltd., S. Grahame

TRANSFERS, LETTERING, ETC.

Stewart Aeronautical Supply Co., Ltd.

TRANSFORMERS

Aeronautical Trades and Manufacturing Co., Ltd.
Ferranti, Ltd.
General Electric Co., Ltd., The
Murphy Radio, Ltd.
Newton Brothers (Derby), Ltd.
Partridge, Wilson and Co., Ltd.
Plessey Co., Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.

TRUCKS (Fork-lift, etc.)

Aerocontacts (Ground Equipment), Ltd.
Aviation Traders (Engineering), Ltd.
Eccles (Birmingham), Ltd.
Electro-Hydraulics, Ltd.
Lansing Bagnall, Ltd.
Mercury Truck and Tractor Co., Ltd., The
Ross, Ltd., S. Grahame
Stone and Co. (Charlton), Ltd., J.

TUBING, AIRCRAFT, STEEL

Accles and Pollock, Ltd.
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Reynolds Tube Co., Ltd.
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.

TUBING, AIRCRAFT STAINLESS

Accles and Pollock, Ltd.
Aerocontacts (Sales), Ltd.
Talbot Stead Tube Co., Ltd.

TUBING, FLEXIBLE.—see Hose, Flexible

TUBING, SEAMLESS

Accles and Pollock, Ltd.
Booth and Co., Ltd., James
British Aluminium Co., Ltd., The
Kaye, Ltd., B. and E.
Northern Aluminium Co., Ltd.
Reynolds Tube Co., Ltd.
Rollet and Co., Ltd., H.
T.I. Aluminium, Ltd.
Talbot Stead Tube Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Tubes, Ltd.
Wiggin and Co., Ltd., Henry

TUBING, OTHER THAN ABOVE

Accles and Pollock, Ltd.
Avica Equipment, Ltd.
Booth and Co., Ltd., James
Crane Packing, Ltd.
Hellermann, Ltd.
Hickman, Ltd.
Imperial Chemical Industries, Ltd.
Ravensbourne Metal Co., Ltd.
Rollet and Co., Ltd., H.
T.I. Aluminium, Ltd.
Talbot Stead Tube Co., Ltd.
Tufnol, Ltd.
Wilson and Sons (London), Ltd., W.

TUBULAR COMPONENTS

Aviation Traders (Engineering), Ltd.
Brown Brothers (Aircraft), Ltd.
Dancer and Hearne Bros., Ltd.
Eagle Aircraft Services, Ltd.
High-Pressure Components, Ltd.
Lancefield Aircraft Components, Ltd.
Pipework and Engineering (Bristol), Ltd.
Ross, Ltd., S. Grahame
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.

TYRES AND WHEELS.—see also Brakes

Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Firestone Tyre and Rubber Co., Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Palmer Tyre, Ltd., The
Stewart Aeronautical Supply Co., Ltd.

UNDERCARRIAGES.—see Landing Gear

UNIFORM.—see Clothing

UPHOLSTERY MATERIALS

Aerocontacts (Sales), Ltd.
B. X. Plastics, Ltd.
Connolly Bros. (Curriers), Ltd.
Dunlop Rubber Co., Ltd., Dulon Division
Hairlok Co., Ltd., The
Imperial Chemical Industries, Ltd.
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Rumbold and Co., Ltd., L. A.

VALVES, ELECTRONIC

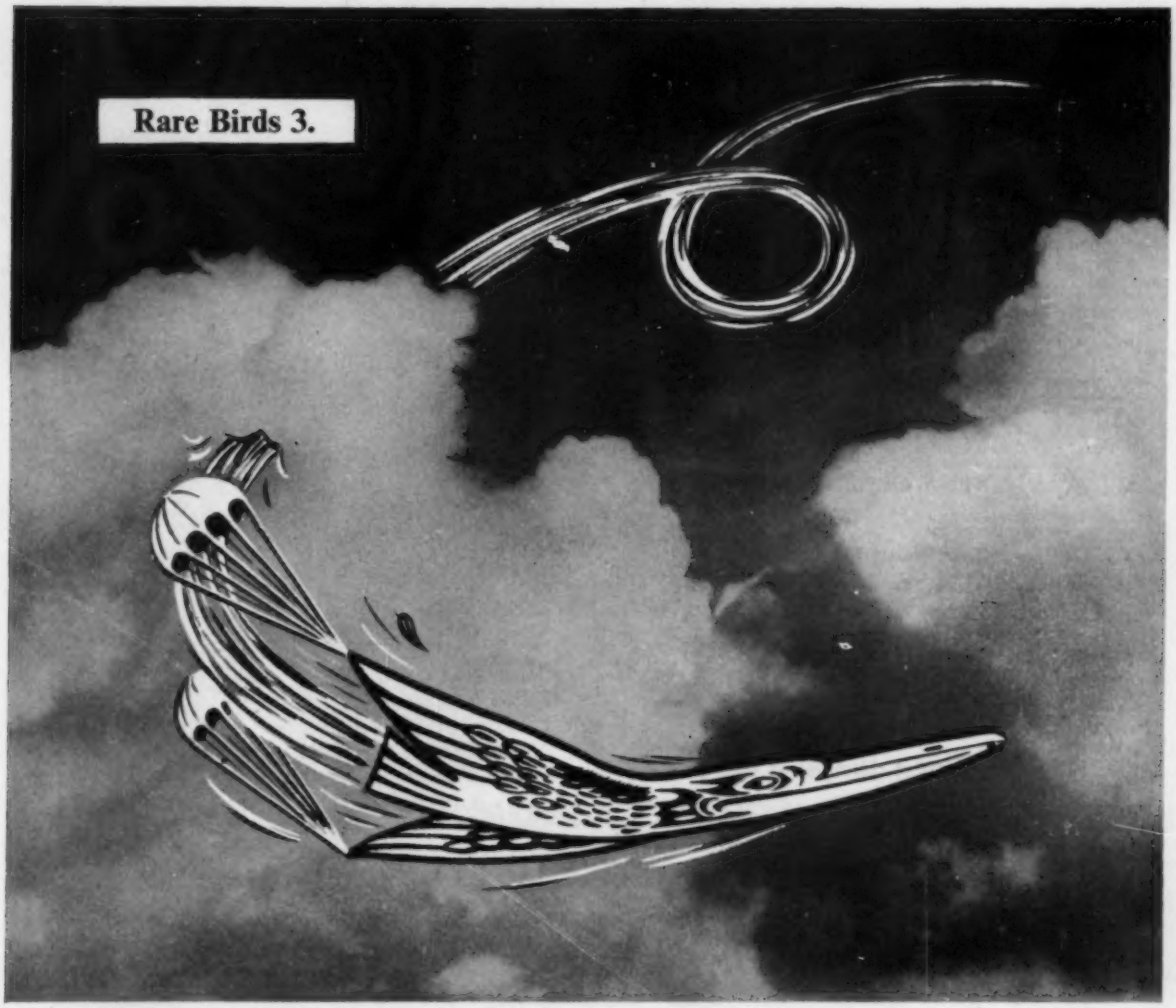
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
British Thomson-Houston Co., Ltd., The
Cossor, Ltd., A. C.
Ferranti, Ltd.
General Electric Co., Ltd., The
Marconi's Wireless Telegraph Co., Ltd.
Mullard, Ltd.
Murphy Radio, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aerodio), Ltd., A. J.

VALVES, PISTON-ENGINE

Aerocontacts (Sales), Ltd.
Field Aircraft Services, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William

VALVES FOR FLUIDS

British Ermeto Corporation, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
H.M.L. (Engineering), Ltd.



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THE ANCILLARY INDUSTRY . . .

Valves for Fluids (continued)

High-Pressure Components, Ltd.
Hobson, Ltd., H. M.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Integral, Ltd.
Kidde Co., Ltd., The Walter
Lockheed Hydraulic Brake Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Saunders Valve Co., Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Vickers-Armstrongs (Aircraft), Ltd.

VALVES FOR AIR AND GASES

British Ermeto Corporation, Ltd.
Bryans Aeroquipment, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Graseby Instruments, Ltd.
H.M.L. (Engineering), Ltd.
High-Pressure Components, Ltd.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Kidde Co., Ltd., The Walter
Normalair, Ltd.
Palmer Tyre, Ltd., The
Peradin and Watercraft, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Saunders Valve Co., Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Siebe, Gorman and Co., Ltd.
Teddington Aircraft Controls, Ltd.
Thompson Bros (Bilston), Ltd.
Vickers-Armstrongs (Aircraft), Ltd.
Williams and James (Engineers), Ltd.

VEHICLES
(other than categories specifically named)

Aerocontacts (Ground Equipment), Ltd.
Aviation Traders (Engineering), Ltd.
Lansing Bagnall, Ltd.
Mercury Truck and Tractor Co., Ltd., The
R.F.D. Co., Ltd.
Thompson Bros. (Bilston), Ltd.

VIBRATION GENERATORS

General Electric Co., Ltd., The
Goodmans Industries, Ltd.
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Accles and Pollock, Ltd., Oldbury, Birmingham. T: Broadwell 1500. TA: Accles, Oldbury, Telex.

Acratork Engineering Co., Ltd., Corys' Buildings, Cardiff. T: Cardiff 31141. TA: Acratork, Cardiff.

Acton Bolt, Ltd., 26 Chase Road, London, N.W.10. T: Elgar 5775. TA: Finethreads, Harles, London.

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Aero Controls, Ltd., Industrial Estate, Weedon Road, Northampton. T: Northampton 33131.

Aerocontacts (Aircraft Distributors), Ltd., Gatwick Airport, Horley, Surrey. T: Horley 1510. TA: Aerocon, Horley.

Aerocontacts (Ground Equipment), Ltd., Gatwick Airport, Horley, Surrey. T: Horley 1510, Ext. 115. TA: Aerocon, Horley.

Aerocontacts (Sales), Ltd., Gatwick Airport, Horley, Surrey. T: Horley 1510. TA: Aerocon, Horley.

Aero Maintenance Equipment, Ltd., 100a Clapham Park Road, London, S.W.4. T: Macaulay 2477-8. TA: Amble, London, S.W.4.

Aerofilms, Ltd., Boreham Wood, Herts. T: Elstree 2214. TA: Astereo, Borehamwood.

Aeronautical Radio Services, Ltd., Doman Road, Camberley, Surrey. T: Camberley 2341/2/3.

Aeronautical Trades and Manufacturing Co., Ltd., 219-223, Camberwell New Road, London, S.E.5. T: Reliance 5437. TA: Aertradman, London, S.E.5.

Aeroplastics, Ltd., Earl Haig Road, Hillington, Glasgow, S.W.2. T: Halfway 1683. TA: Aeroplastic, Glasgow.

Aero Research, Ltd., Duxford, Cambridge. T: Sawston 2121. TA: Aerodux, Cambridge.

Aircraft Materials, Ltd., Midland Road, London, N.W.1. T: Euston 6151. TA: Airworthy, Norwest, London.

Airscrew Co. and Jicwood, Ltd., The, Weybridge, Surrey. T: Weybridge 2242. TA: Airscrew, Weybridge.

Air Service Training, Ltd., Hamble, Southampton, Hants. T: Hamble 3001 (9 lines). TA: Training, Hamble.

Aircraft Marine Products (Great Britain), Ltd., 60 Kingly Street, London, W.1. T: Regent 2517-8, 3681-3. TA: Ampio, London.

Air Trainers, Ltd., Bicester Road, Aylesbury, Bucks. T: Aylesbury 4611. TA: Trainair, Aylesbury.

Airwork, Ltd., Airwork House, 35 Piccadilly, London, W.1. T: Regent 8494. TA: Airwork, Piccy.

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Amal, Ltd., Holdford Road, Witton, Birmingham, 6. T: Birchfields 4571. TA: Amalcarb, Phone, Birmingham 6.

Anticoustic Co., The, 204 High Street, Guildford, Surrey. T: Guildford 66488.

Armstrong Patents Co., Ltd., Eastgate, Beverley, Yorkshire. T: Beverley 82212. TA: Armstrong Patents, Beverley.

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Autoset (Production), Ltd., Stour Street, Birmingham 18. T: Edgbaston 1143.

Auto-Klean Strainers, Ltd., Lascar House, Staines Road, Hounslow, Middlesex. T: Hounslow 6441. TA: Auto-Klean, Hounslow.

Automatic Coil Winder and Electrical Equipment Co., Ltd., The, Avocet House, 92-96 Vauxhall Bridge Road, London, S.W.1. T: Victoria 3404. TA: Autowinda, Sowest, London.

Automotive Products Co., Ltd., Tachbrook Road, Leamington Spa. T: Leamington Spa 2700. TA: Autoducts, Phone, Leamington Spa.

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Aviation and Engineering Projects, Ltd., Alexandra Road, Hounslow, Middlesex. T: Hounslow 9621.

Aviation Developments, Ltd., Kingsbourne House, 229/231 High Holborn, London, W.C.1. T: Chancery 8601. TA: Avidev, Holb, London.

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Aviation Traders, Ltd., 15 Great Cumberland Place, London, W.1. T: Ambassador 2091. TA: Aviatrade Wesdo, London.

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Avica Equipment, Ltd., Mark Road, Hemel Hempstead, Herts. T: Boxmoor 4711. TA: Avica, Hemel Hempstead.

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Boulton Paul Aircraft, Ltd., Wolverhampton, Staffs. T: Fordhouses 3191. TA: Aircraft, Wolverhampton.

Bowden (Engineers), Ltd., Victoria Road, Willesden Junction, London, N.W.10. T: Elgar 4805. TA: Bowirelim, Norphone.

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Briggs Motor Bodies, Ltd., Chequers Lane, Dagenham, Essex. T: Rainham 680. TA: Brigmotor, Telex, London.

British Aluminium Co., Ltd., The, Norfolk House, St. James's Square, London, S.W.1. T: Whitehall 7868. TA: Britalumin, London, Telex.

British Aviation Insurance Company, Ltd., The, 3/4 Lime Street, London, E.C.3. T: Mansion House 0444 (6 lines). TA: Aviacoy, Lime, London.

British Belting and Asbestos, Ltd., Scandinavia Mills, Cleckheaton, Yorkshire. T: Cleckheaton 800. TA: Belting, Cleckheaton.

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British Insulated Callender's Cables, Ltd., 21 Bloomsbury Street, London, W.C.1. T: Museum 1600. TA: Bicalbest, Westcent, London.

British Manufacture and Research Co., Ltd., Springfield Road, Grantham, Lincs. T: Grantham 700, 701 and 1700. TA: Marco, Grantham.

British Manufactured Bearings Co., Ltd., Boscobel, High Street, Crawley, Sussex. T: Crawley 1030. TA: Briman, Crawley.

British Messier, Ltd., Cheltenham Road, Gloucester. T: Churchdown 3281. TA: Messier, Phone, Gloucester.

British Oxygen Gases, Ltd., The, Bridgewater House, Cleveland Row, St. James's, London, S.W.1. T: Whitehall 9777. TA: Oxygen, Piccy, London.

British Oxygen Aro Equipment, Ltd., Bridgewater Row, St. James's, London, S.W.1. T: Whitehall 9777. TA: Britoxygen, Piccy.

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British Thomson-Houston Co., Ltd., The, Rugby, Warwickshire. T: Coventry 64181. TA: Asteroidal, Coventry.

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Brown, Ltd., S. G., Shakespeare Street, Watford, Herts. T: Watford 7241. TA: Sidbrowniz, Watford.

Brown Bayley Steels, Ltd., Leeds Road, Sheffield 9. T: Sheffield 41031.

Brown Brothers (Aircraft), Ltd., Great Eastern Street, London, E.C.2. T: Bishopsgate 7654. TA: Imbrowned, Phone, London, E.C.2.

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Brown Industries, Ltd., David, 96-97 Piccadilly, London, W.1. T: Grosvenor 7747. TA: Davibron, Audley, London.

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Brown Tractors (Engineering), Ltd., David, Meltham, Nr. Huddersfield. T: Meltham 361. TA: Farming, Meltham.

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Burgess and Co., Ltd., G. H., Alpha Works, Havelock Road, Southall, Middlesex. T: Southall 1816/2821.

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Burnley Aircraft Products, Ltd., Fulledge Works, Holmes Street, Burnley, Lancs. T: Burnley 3121-2 and 3203 (3 lines). TA: Aircraft, Burnley.

C.W.C. Equipment, Ltd., Acorn Works, Kings Grove, Maidenhead, Berks. T: Maidenhead 2275. TA: Duraquip, Maidenhead.

Campbell (Engineers), Ltd., J. R., Argyll Works, Fairlie Road, Trading Estate, Slough, Bucks. T: Slough 22381/2/3. TA: Gears, Slough.

Carlisle and Co., Ltd., C. G., 629 Penistone Road, Sheffield, 6, Yorkshire. T: Sheffield 48791. TA: Nichrome, Sheffield.

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Connolly Bros. (Curriers), Ltd., 39-43 Chalton Street, London, N.W.1. T: Euston 1661. TA: Cowhide, London.

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Delaney Gallay, Ltd., Vulcan Works, Edgware Road, Cricklewood, London, N.W.2. T: Gladstone 2201.

Dent and Co., and Johnson, Ltd., Linwood, Renfrewshire, Scotland. T: Johnstone 109. TA: Dentcompa, Linwood, Renfrewshire.

Derby Aviation, Ltd., Derby Airport, Burnaston, Derby. T: Etwall 323.

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Dowty Fuel Systems, Ltd., Arle Court, Cheltenham, Glos. T: Cheltenham 53471. TA: Dowty, Cheltenham, Telex.

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Elliott Brothers (London), Ltd., Century Works, London, S.E.13. T: Tideway 3232. TA: Ohm, Telex, London.

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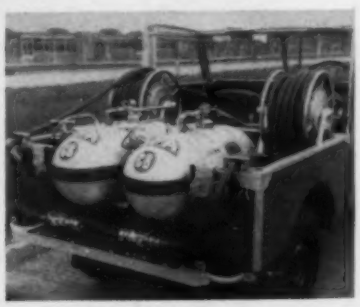

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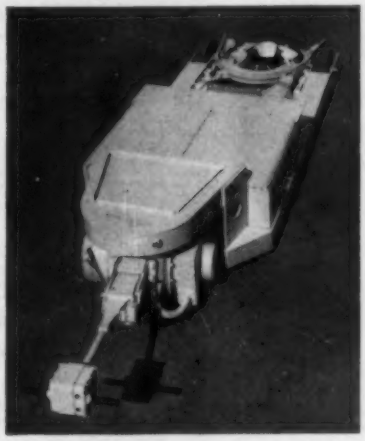

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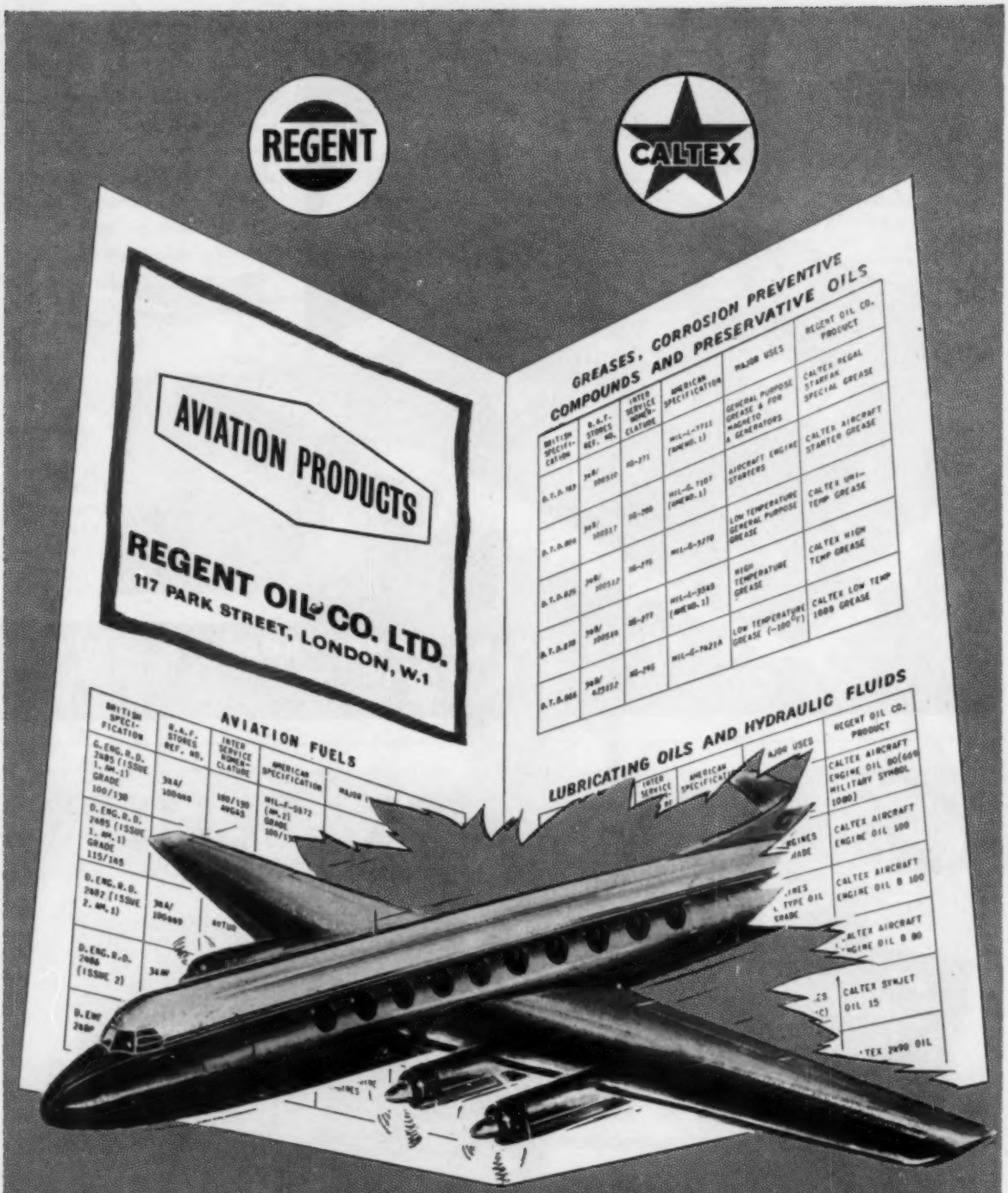

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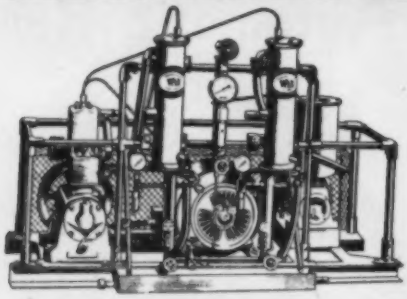

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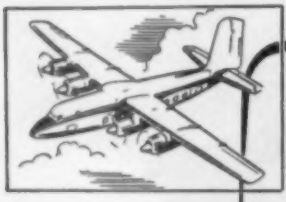

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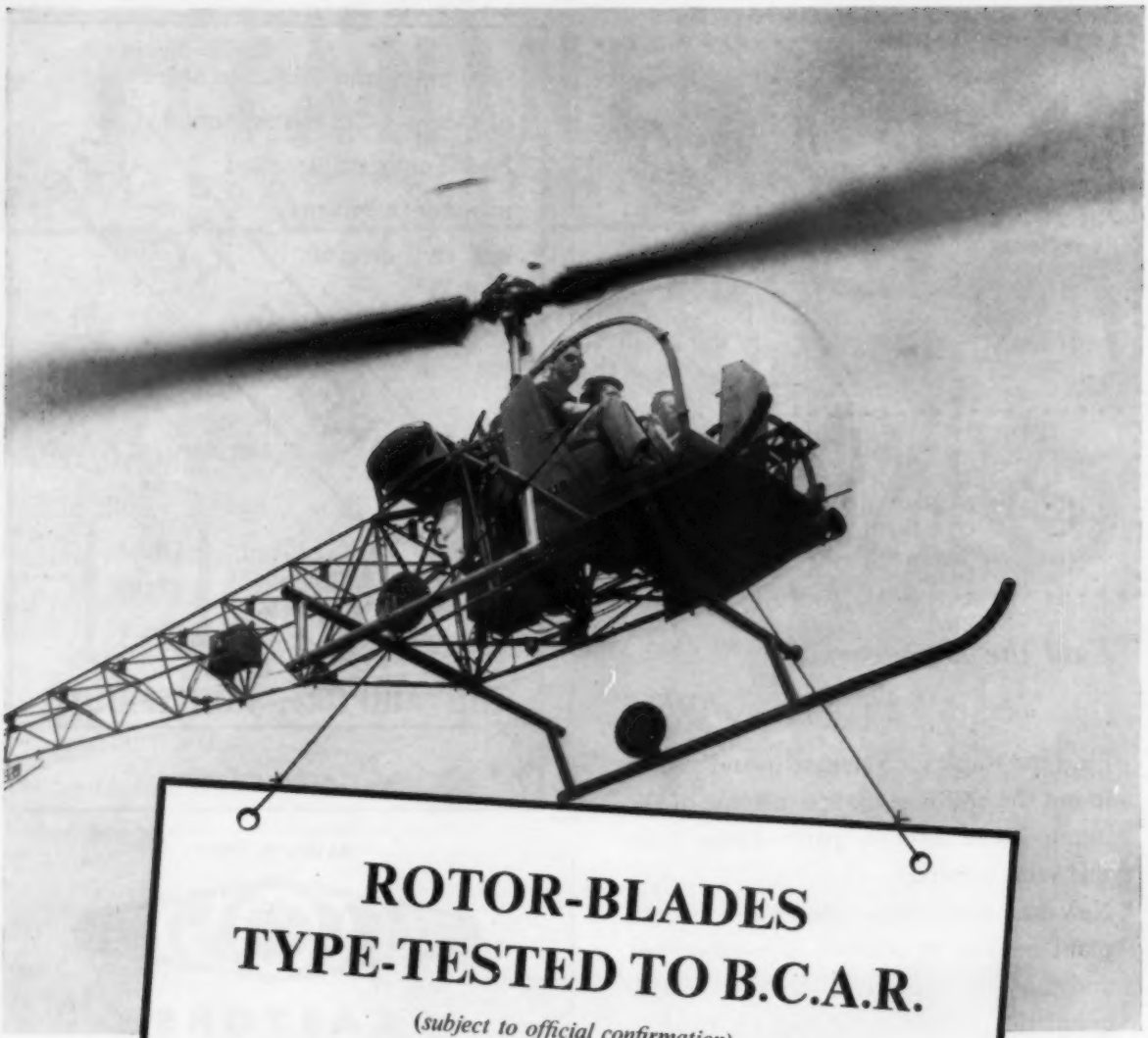

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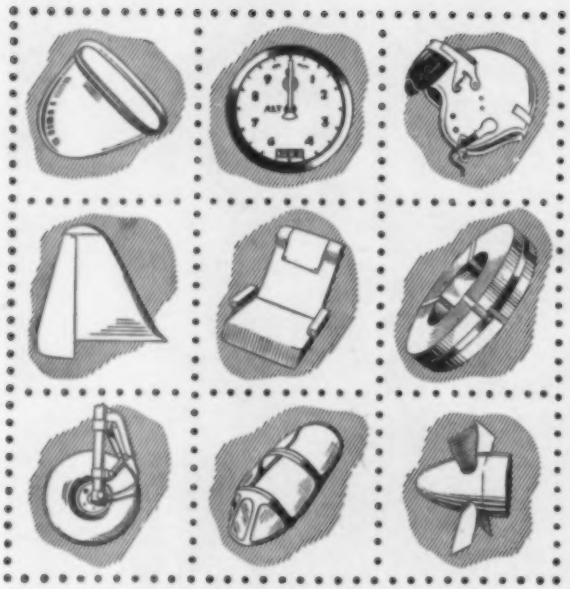

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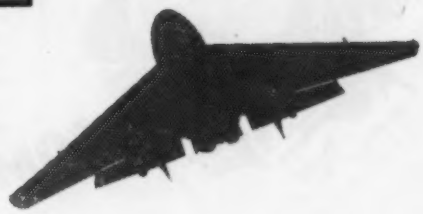

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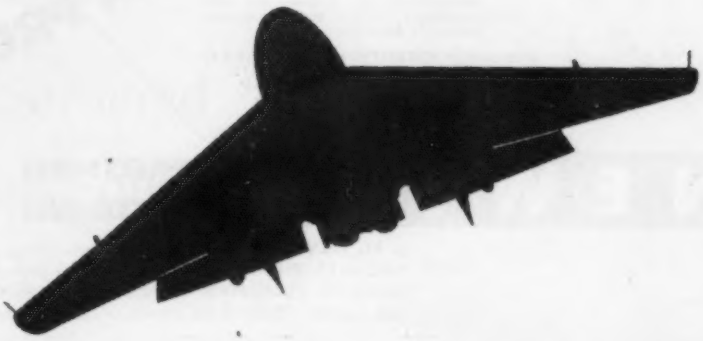

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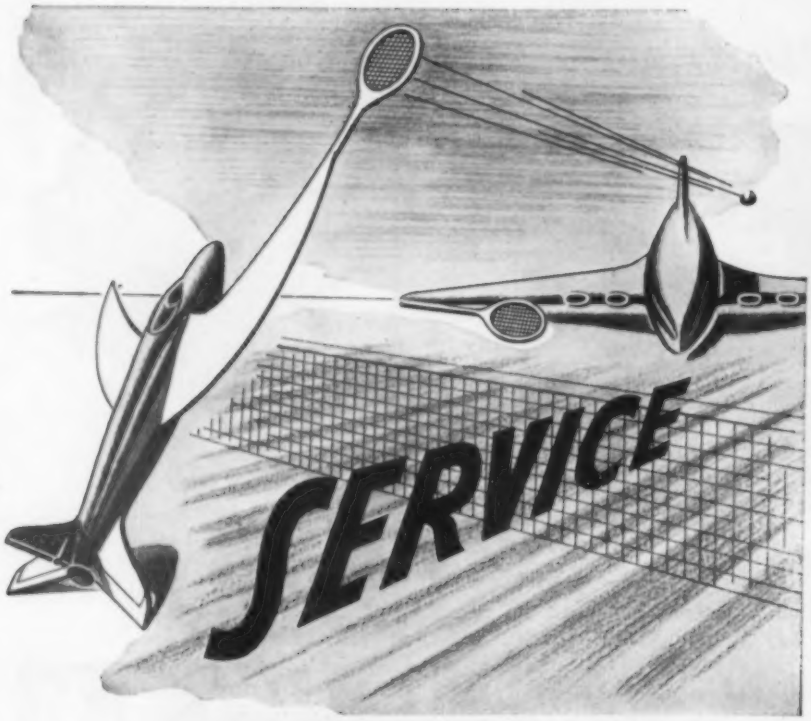

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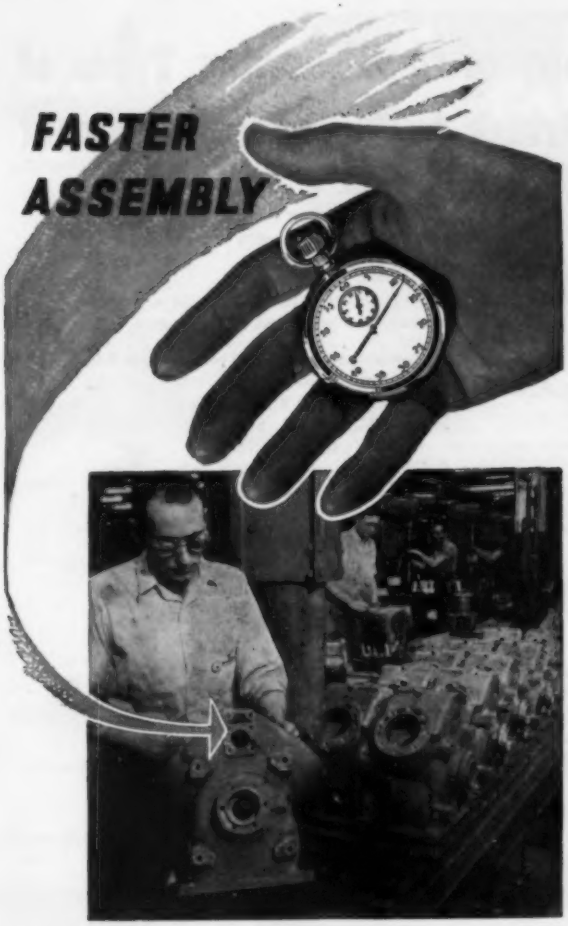

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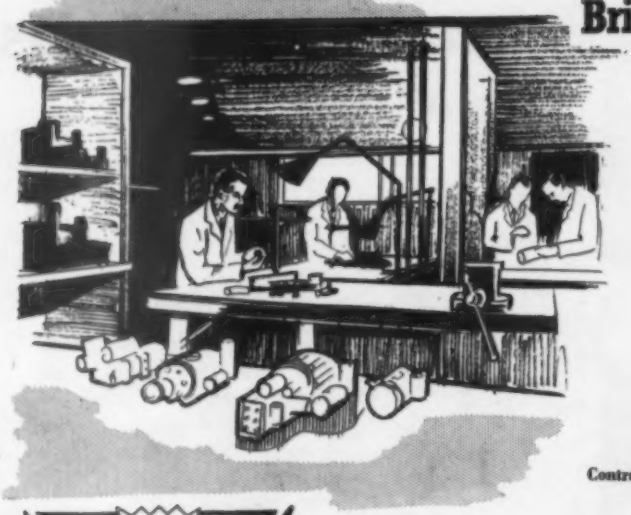

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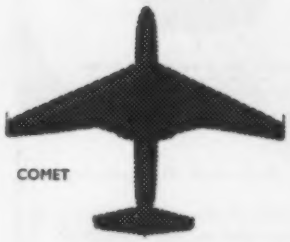
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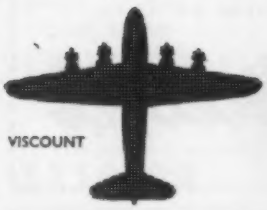
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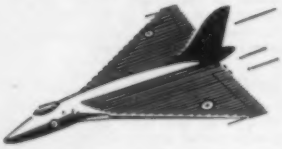

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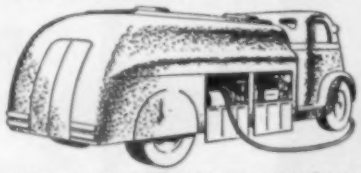

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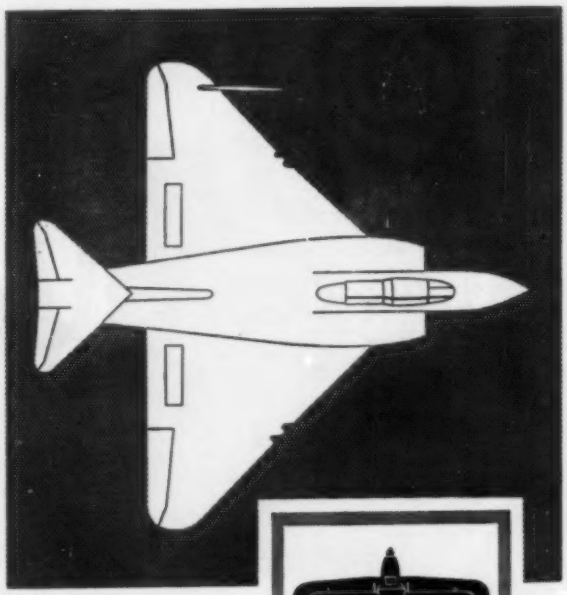

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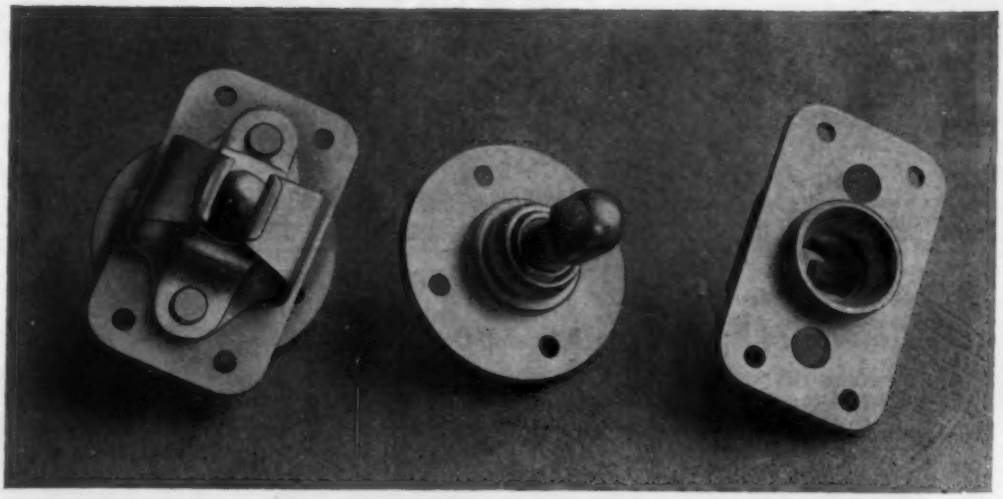

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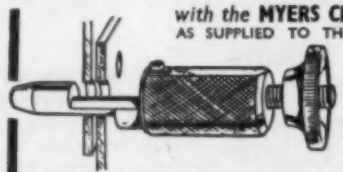

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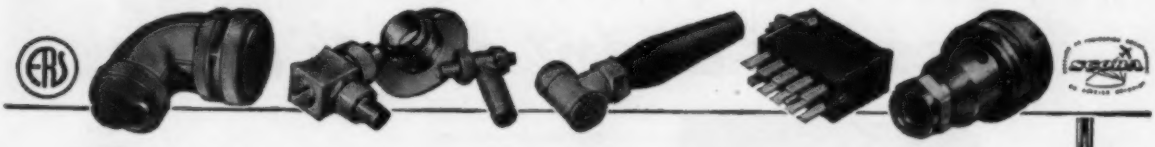

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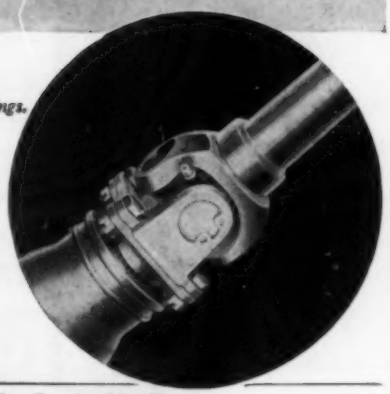

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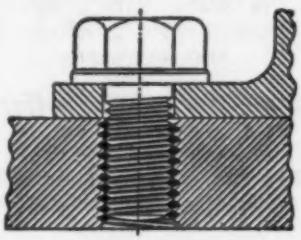

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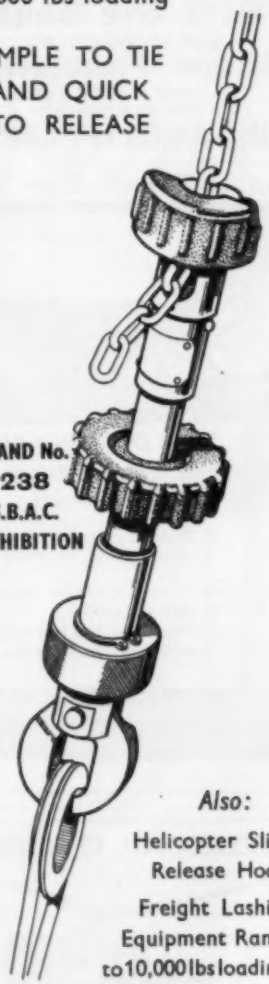

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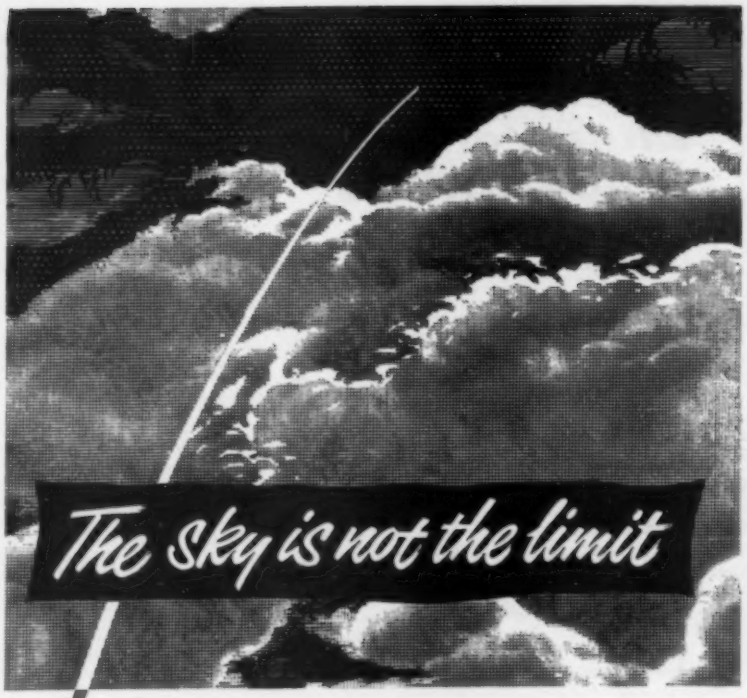

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